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Volume II

AN AUTOMATED PROCEDURE FOR FLUTTER AND STRENGTH ANALYSIS AND OPTIMIZATION OF AEROSPACE VEHICLES
Volume II. Program User's Manual

GRUMMAN AEROSPACE CORPORATION
BETHPAGE, NEW YORK 11714

DECEMBER 1975

TECHNICAL REPORT AFFDL-TR-75-137, Volume II
FINAL REPORT FOR PERIOD MARCH 1972 – DECEMBER 1975

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This report has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This volume contains the detailed instructions needed to use the Flutter And STrength Optimization Program (FASTOP). The program is capable of both integrated analysis and efficient (near-minimum weight) sizing of cantilever and free-free lifting surface structures in the presence of strength and flutter-speed constraints. FASTOP consists of two major sub-programs, namely

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20. ABSTRACT (Continued)

the Structural Optimization Program (SOP), and the Flutter Optimization Program (FOP).

The volume contains the following four parts:

A. Fastop Overview

This part describes the modular organization of FASTOP. In addition, the interrelationship of the input/output computer storage units is discussed.

B. Usage/Input/Output for Structural Optimization Program

The Usage section provides general information about SOP modular capabilities and limitations. Detailed instructions for the preparation of card data for SOP are given in the Input section. The Output section describes the most important output items from the various modules in SOP.

C Usage/Input/Output for Flutter Optimization Program

This part is similar to part B except that it refers to FOP.

D. Program Execution

This part contains a discussion of the clue data related to the most important analysis/redesign options in FASTOP. The JCL requirements of the important options are also presented here.

FOREWORD

This final report was prepared by the Structural Mechanics Section of the Grumman Aerospace Corporation, Bethpage, New York, for the Vehicle Dynamics and Structures Division, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio. The work was performed under Contract No. F33615-72-C-1101, which was initiated under Project No. 1370, "Dynamic Problems in Flight Vehicles", Task No. 01, "Aeroelastic Problems". Initially Mr. R. F. Taylor (FYS) and Dr. V. B. Venkayya (FBR) were the Project Monitors of this contract, after which Capt. S. M. Batill (FYS) assumed this position.

The report consists of two volumes. Volume I, entitled "Theory and Application", describes the analysis and redesign procedures provided by a computer program system for minimum-weight design of cantilever or free-free lifting-sruface structures subject to combined strength and flutter-speed requirements. Detailed instructions required to use this Flutter And STrength Optimization Program (FASTOP) are provided in Volume II, entitled "Program User's Manual". The report, which covers work conducted between 15 March 1972 and 31 December 1975, was submitted to the Air Force in December 1975.

Dr. W. Lansing was the Program Manager and Mr. K. Wilkinson was the Project Engineer. Principal contributors to the project and their associated areas of responsibility include: Messrs. D. George and G. R. Schriro - Overall Program Integration and Final Checkout; Dr. J. Markowitz - Integration of Flutter Redesign and Strength Redesign Program Functions; Messrs. E. Lerner and J. H. Berman - Evaluation of Candidate Flutter Redesign Procedures; Messrs. R. R. Chipman and M. Chernoff - Development of Integrated Flutter Analysis Module; Dr. W. J. Dwyer - Strength Analysis and Redesign Module; Mr. P. Shyprykevich - Applied Loads Analysis Module; Messrs. M. J. Shapiro and S. Goldenberg - Vibration Analysis Module. The continued assistance and advice of Mr. J. Smedfjeld and Capt. S. M. Batill have been greatly appreciated. The authors also wish to acknowledge Mr. W. Mykytow and Dr. L. Berke for initiating this effort and for their valuable suggestions during the course of the project.

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INTRODUCTION

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THE FLUTTER AND STRENGTH OPTIMIZATION PROGRAM (FASTOP) MODULES ARE AS FOLLOWS.

STRENGTH OPTIMIZATION PROGRAM (SOP)

1. AUTOMATED LOAD ANALYSIS MODULE (ALAM)
2. AUTOMATED STRENGTH ANALYSIS MODULE (ASAM)
3. AUTOMATED STRENGTH OPTIMIZATION MODULE (ASOM)
4. AUTOMATED TRANSFORMATION ANALYSIS MODULE (ATAM)

FLUTTER OPTIMIZATION PROGRAM (FOP)

1. AUTOMATED VIBRATION ANALYSIS MODULE (AVAM)
2. AUTOMATED FLUTTER ANALYSIS MODULE (AFAM)
3. AUTOMATED FLUTTER OPTIMIZATION MODULE (AFOM)

THE PROGRAM USER'S MANUAL (VOLUME II) CONSISTS OF FOUR MAJOR PARTS, THE CONTENTS OF WHICH ARE DESCRIBED BELOW.

PART A (OVERVIEW)

THIS PART CONSISTS OF THE FOLLOWING

- OVERVIEW OF FASTOP.
- FIGURES.

THIS PART OF THE USER'S MANUAL SERVES THE DUAL PURPOSE OF PROVIDING AN OVERVIEW OF FASTOP, WHICH TO SOME EXTENT DUPLICATES THE INFORMATION CONTAINED IN VOLUME I OF THIS FINAL REPORT, AND ALSO INDICATES THE PROGRAM STORAGE UNITS AND DATA CONTAINED ON THESE UNITS FOR THE VARIOUS ANALYSIS AND REDESIGN PROGRAM OPTIONS.

THE INTERELATIONSHIP OF THE INPUT/OUTPUT STORAGE UNITS FOR BOTH THE STRUCTURAL OPTIMIZATION PROGRAM (SOP) AND FLUTTER OPTIMIZATION PROGRAM (FOP) IS GIVEN IN FIGURES 10 AND 11, RESPECTIVELY. FOR THE USER WHO WISHES TO PREPARE THE INPUT DATA

CARDS AND EXECUTE THE PROGRAM. FIGURES 12 AND 13 WILL BE USEFUL IN DIRECTING HIM TO THE APPROPRIATE SECTIONS OF THE MANUAL.

PART B (SOP - USAGE, INPUT, AND OUTPUT)

THIS PART CONSISTS OF THREE MAIN SECTIONS DESCRIBING USAGE, INPUT, AND OUTPUT FOR SOP.

THE USAGE SECTION PROVIDES GENERAL TYPE INFORMATION ABOUT SOP MODULAR CAPABILITIES AND LIMITATIONS. A NUMBER OF FIGURES HAVE BEEN INCLUDED FOR EACH MODULE TO AID THE USER IN THE DISCUSSION. NOTE THAT EACH GROUP OF FIGURES IS INCLUDED AT THE END OF THE DISCUSSION ASSOCIATED WITH A PARTICULAR MODULE.

THE INPUT SECTION PROVIDES INSTRUCTIONS FOR PREPARATION OF CARD INPUT DATA FOR EACH OF THE MODULES. REFERENCE IS MADE TO THE FIGURES APPEARING IN THE USAGE SECTION. CARD INPUT DATA PREPARATION CONSISTS OF DATA OR LOGIC ITEMS. A DATA ITEM DESCRIBES THE VARIABLES, FORMAT, NUMBER OF CARDS AND SUBROUTINE WHICH ENTERS THE DATA INTO THE PROGRAM. A LOGIC ITEM PROVIDES INFORMATION AS TO WHICH OF THE DATA ITEMS WHICH FOLLOW THE LOGIC ITEM ARE TO BE INCLUDED OR EXCLUDED DEPENDING UPON THE CONTROL WORD OPTIONS. ALL INFORMATION ASSOCIATED WITH A PARTICULAR ITEM IS ENCLOSED WITHIN ASTERISKS, WITH ADDITIONAL REMARKS INCLUDED WHERE APPLICABLE BEFORE OR AFTER THE ITEM NUMBER.

THE OUTPUT SECTION DESCRIBES THE MOST IMPORTANT OUTPUT FROM THE MAIN SOP PROGRAM AND THE ASSOCIATED MODULES. CERTAIN INTERMEDIATE OUTPUT IS NOT INCLUDED.

PART C (FOP - USAGE, INPUT, AND OUTPUT)

THIS PART CONSISTS OF THREE MAIN SECTIONS DESCRIBING USAGE, INPUT, AND OUTPUT FOR FOP.

REMARKS ABOUT USAGE, INPUT, AND OUTPUT MADE IN PART B ARE ALSO APPLICABLE TO PART C.

PART D (PROGRAM EXECUTION)

THIS PART CONSISTS OF TWO MAIN SECTIONS

- CLUE DATA FOR IMPORTANT FASTOP OPTIONS AND DATA INPUT CHANGES BETWEEN A FIRST AND SECOND PASS.

- MAJOR ANALYSIS AND OPTIMIZATION OPTIONS, AND RELATED JCL REQUIREMENTS

THE FIRST SECTION IS PRIMARILY A DISCUSSION OF CLUE DATA

RELATED TO IMPORTANT ANALYSIS/REDESIGN OPTIONS FOLLOWED BY A DESCRIPTION OF DATA CHANGES REQUIRED BETWEEN A FIRST AND SUBSEQUENT PASS WHEN ACCOMPLISHING REDESIGN. FIGURES 1 TO 6 PROVIDE THIS INFORMATION. ADDITIONAL DISCUSSION IS ALSO PROVIDED ABOUT DISK ORIENTED SEQUENTIAL INPUT/OUTPUT (DSIO).

IN THE SECOND SECTION THE JCL REQUIREMENTS ARE SUMMARIZED FOR THE MAJOR SOP - FOP ANALYSIS AND OPTIMIZATION OPTIONS.

PART A

FASTOP OVERVIEW

THE FASTOP USER'S MANUAL HAS BEEN WRITTEN WITH THE ASSUMPTION THAT THE USER IS FAMILIAR WITH THE ENGINEERING TERMINOLOGY INVOLVED IN THE VARIOUS ANALYSIS AND REDESIGN FUNCTIONS PERFORMED BY THIS PROGRAM. IN AREAS WHERE SOME UNCERTAINTY MIGHT EXIST, THE READER IS DIRECTED TO VOLUME I OF THIS REPORT, SUBTITLED 'THEORY AND APPLICATION' WHICH CONTAINS A COMPREHENSIVE DESCRIPTION OF THE FASTOP SYSTEM. IN COMPLEX AREAS OF THE USER'S MANUAL, FIGURES OR WRITTEN DESCRIPTIONS HAVE BEEN INCLUDED TO AID THE USER IN PROVIDING THE PROGRAM INPUT DATA. IT IS IMPORTANT TO NOTE, HOWEVER, THAT A WORKING KNOWLEDGE OF THE TWO MAJOR DISCIPLINES INVOLVED IN THIS PROGRAM, NAMELY FINITE-ELEMENT STRUCTURAL ANALYSIS AND DYNAMIC (VIBRATION AND FLUTTER) ANALYSIS IS OF OBVIOUS BENEFIT IN PREPARING DATA. IN LINE WITH THE WELL-DEFINED DISTINCTION BETWEEN THESE TWO DISCIPLINES, THE FASTOP PROGRAM SYSTEM HAS BEEN DIVIDED INTO TWO MAJOR PROGRAMS, THE FIRST ADDRESSING STRENGTH OPTIMIZATION, AND THE SECOND, FLUTTER OPTIMIZATION.

THIS SECTION OF THE USER'S MANUAL SERVES THE DUAL PURPOSE OF PROVIDING AN OVERVIEW OF FASTOP, WHICH TO SOME EXTENT DUPLICATES THE INFORMATION CONTAINED IN THE PREVIOUSLY REFERENCED FINAL REPORT, AND ALSO INDICATES THE PROGRAM STORAGE UNITS AND DATA CONTAINED ON THESE UNITS FOR THE VARIOUS ANALYSIS AND REDESIGN PROGRAM OPTIONS.

THE FLUTTER AND STRENGTH OPTIMIZATION PROGRAM (FASTOP) MODULES ARE AS FOLLOWS.

STRENGTH OPTIMIZATION PROGRAM (SOP)

1. AUTOMATED LOAD ANALYSIS MODULE (ALAM)
2. AUTOMATED STRENGTH ANALYSIS MODULE (ASAM)
3. AUTOMATED STRENGTH OPTIMIZATION MODULE (ASOM)
4. AUTOMATED TRANSFORMATION ANALYSIS MODULE (ATAM)

FLUTTER OPTIMIZATION PROGRAM (FOP)

1. AUTOMATED VIBRATION ANALYSIS MODULE (AVAM)
2. AUTOMATED FLUTTER ANALYSIS MODULE (AFAM)
3. AUTOMATED FLUTTER OPTIMIZATION MODULE (AFOM)

A SCHEMATIC DIAGRAM OF THE FASTOP SYSTEM IS SHOWN IN FIGURE 1.

DETAILED DISCUSSION OF THE SOP SYSTEM BEGINS ON THE NEXT PAGE, WITH THE FOP SYSTEM DISCUSSION FOLLOWING SOP.

THE TWO MAJOR PROGRAMS MAY BE EXECUTED SINGLY WITHOUT COMMUNICATION. FOR EXAMPLE, SOP MAY BE USED TO PERFORM ONLY

STRENGTH ANALYSIS. ALTERNATIVELY, FOP MAY BE USED TO PERFORM FLUTTER ANALYSIS ONLY, USING THE PROGRAM OPTION WHERE MODAL INPUT DATA IS ENTERED ON CARDS. IN AN ANALYSIS MODE, COMMUNICATION BETWEEN THE TWO PROGRAMS WILL EXIST IF SOP IS USED TO GENERATE THE STIFFNESS OR FLEXIBILITY MATRIX REQUIRED FOR VIBRATION ANALYSIS IN FOP. WHEN FASTOP IS USED FOR COMBINED STRENGTH/FLUTTER REDESIGN, SOP MUST BE THE FIRST PROGRAM EXECUTED IN THE ENTIRE PROCEDURE AND THE TWO PROGRAMS ARE USED IN AN ALTERNATING SEQUENCE THEREAFTER.

SOP OVERVIEW AND DEFINITION OF PROGRAM INPUT/OUTPUT UNITS

THE FASTOP MODULAR FLOW CHART SHOWN IN FIGURE 1 PROVIDES THE TOTAL RELATIONSHIP OF THE TWO MAJOR PROGRAMS AND THEIR ASSOCIATED MODULES. A SIMPLIFIED MODULAR CHART OF THE PHYSICAL STRUCTURE OF THE MAIN PROGRAM AND ASSOCIATED MODULES FOR SOP IS SHOWN IN FIGURE 2.

SUBSEQUENT TO THE INITIAL SOP EXECUTION A MULTI-STEP SOP-FOP OR FOP-SOP EXECUTION MAY BE INITIATED TO ACCOMPLISH REDESIGN. FOR DETAILS OF THE FOP EXECUTION SEE SECTION TITLED 'FOP OVERVIEW AND DEFINITION OF PROGRAM INPUT/OUTPUT UNITS' AND PART C.

THE FUNCTION OF EACH SOP MODULE IS BRIEFLY SUMMARIZED IN FIGURES 3 TO 5. DATA GENERATED BY THE VARIOUS SOP MODULES CAN BE SAVED ON DISKS AND/OR TAPES. THESE DATA, WHICH ARE USED EITHER AS INPUT FOR A SUBSEQUENT SOP ANALYSIS OR A SUBSEQUENT FOP ANALYSIS, FALL INTO ONE OF THREE GROUPS HAVING THE FOLLOWING DATA-SET NAMES

SOP.UNIT17
SOTOFO.PNN
SOTOSO.PNN

THE FUNCTION OF EACH OF THESE DATA-SETS AND THE INFORMATION CONTAINED IN THEM ARE DESCRIBED BELOW. TO AID THE READER IN UNDERSTANDING THE INTER-RELATIONSHIP OF THE VARIOUS INPUT/OUTPUT DATA DISCUSSED IN THIS SECTION OF THE USER'S MANUAL, THE READER IS REFERRED TO FIGURES 10 AND 11.

I. SOP.UNIT17

THIS DATA UNIT (UNIT17) IS USED TO STORE FORTRAN FILES OF DATA GENERATED BY THE LOADS AND TRANSFORMATION MODULES, ALAM AND ATAM. (THIS UNIT17 DIFFERS FROM THE ONE IN FOP WHICH HAS VIBRATION INFORMATION.) THE TOTAL NUMBER OF FILES GENERATED IN ANY COMPUTER RUN IS A FUNCTION OF THE OPTIONS EXERCISED IN THESE

TWO MODULES. A SUMMARY OF THE SPECIFIC DATA STORED ON UNIT17 BY ALAM AND ATAM AND THE FILE NUMBERS ASSIGNED THIS DATA WILL APPEAR AT THE END OF THE SOP COMPUTER RUN IN WHICH THE DATA WERE GENERATED. THIS FILE INFORMATION MUST BE SPECIFIED AS INPUT DATA FOR ANY SUBSEQUENT EXECUTION OF THE LOAD, TRANSFORMATION OR STRENGTH MODULES IN WHICH THE SAVED DATA ARE TO BE USED. IT IS NOTED THAT UNIT17 WILL BE AN INPUT UNIT FOR THIS PARTICULAR RUN.

THE SPECIFIC CATEGORIES OF DATA THAT MAY BE STORED ON UNIT17 FOLLOWS.

1. GENERAL TYPE INFORMATION (GEOMETRY, PANEL AREAS) FOR SUBSONIC FLOW ANALYSIS.
2. AERODYNAMIC GRID GEOMETRY FOR SUBSONIC FLOW ANALYSIS.
3. RIGID SURFACE SYMMETRIC AND/OR ANTISYMMETRIC AERODYNAMIC INFLUENCE COEFFICIENT MATRICES (AERODYNAMICS GRID) FOR A NUMBER OF MACH NUMBERS AND UNIT PRESSURES AND FOR SUBSONIC FLOW ANALYSIS.
4. GENERAL TYPE INFORMATION (GEOMETRY, PANEL AREAS) FOR SUPERSONIC FLOW ANALYSIS.
5. AERODYNAMIC GRID GEOMETRY FOR SUPERSONIC FLOW ANALYSIS.
6. RIGID-SURFACE SYMMETRIC AND/OR ANTISYMMETRIC AERODYNAMIC INFLUENCE COEFFICIENT MATRICES (AERODYNAMICS GRID) FOR A NUMBER OF MACH NUMBERS AND UNIT PRESSURES AND FOR SUPERSONIC FLOW ANALYSIS.
7. TRANSFORMATION MATRIX FROM THE AERODYNAMICS TO THE STRUCTURES GRID.
8. PANEL AERODYNAMIC LOADS IN THE STRUCTURES GRID.
9. WEIGHTS GRID GEOMETRY.
10. TRANSFORMATION MATRIX FROM THE WEIGHTS TO THE STRUCTURES GRID.
11. PANEL INERTIAL LOADS IN THE STRUCTURES GRID.
12. TOTAL PANEL LOADS IN THE STRUCTURES GRID.
13. DYNAMICS GRID GEOMETRY.
14. TRANSFORMATION MATRIX FROM THE DYNAMICS TO THE STRUCTURES GRID.

II. SOTOFO.PNN

THIS NAME IDENTIFIES OUTPUT DATA GENERATED BY THE ASAM/ASOM MODULE OF SOP ON DSIO (DISK SEQUENTIAL INPUT/OUTPUT) UNIT NUMBER 9. SINCE INTERACTIVE REDESIGN REQUIRES MULTIPLE SEQUENTIAL SUBMISSIONS OF BOTH SOP AND FOP, IT FOLLOWS THAT A NUMBER OF SOTOFO.PNN TAPES WILL BE GENERATED BY SOP IN THE COURSE OF A REDESIGN ANALYSIS. THE NUMBER NN IS RESERVED FOR THE USER TO IDENTIFY THE PARTICULAR PASS OR CYCLE OF REDESIGN IN WHICH A PARTICULAR SOTOFO TAPE WAS GENERATED. THE VALUE OF NN WILL THEREFORE BE ONE OR LARGER. AS ITS NAME IMPLIES THE SOTOFO TAPE IS A TAPE GENERATED BY SOP TO BE USED AS INPUT TO FOP. THE NUMBER OF FILES GENERATED ON THIS UNIT IS DEPENDENT ON WHETHER THE USER HAS CHOSEN TO ACCEPT ALL DEGREES OF FREEDOM OF THE STRUCTURES MODEL AS DYNAMICS DEGREES OF FREEDOM FOR VIBRATION MODE CALCULATIONS, OR IF HE CHOOSES TO REDUCE THE STRUCTURES

MODEL DEGREES OF FREEDOM USING A FORCE BEAMING TRANSFORMATION PROCEDURE. IN THE FORMER CASE THE STRUCTURES MODEL STIFFNESS MATRIX WILL BE SAVED ON THE SOTOFO TAPE (THE 'STIFFNESS APPROACH') AND IN THE LATTER CASE THE DYNAMICS MODEL FLEXIBILITY MATRIX WILL BE SAVED (THE 'FLEXIBILITY APPROACH'). THESE DATA ARE SUBSEQUENTLY USED AS INPUT TO THE AVAM MODULE IN FOP TO CALCULATE VIBRATION MODES. ADDITIONAL FILES CONTAINING RIGID BODY MODE TRANSFORMATION MATRICES ARE STORED ON THE SOTOFO UNIT WHEN FREE FREE MODES OF VIBRATION ARE TO BE COMPUTED IN AVAM. THE REMAINING DATA FILES ARE CONCERNED EXCLUSIVELY WITH FLUTTER REDESIGN AND INCLUDE THE ELEMENT GAGES RESULTING FROM THE MOST RECENT ASOM ANALYSIS PLUS TRANSFORMATION DATA REQUIRED TO COMPUTE FLUTTER VELOCITY DERIVATIVES WHEN USING THE 'FLEXIBILITY APPROACH'. THE SPECIFIC DATA FILES AND DESCRIPTIONS FOLLOW.

SOTOFO.PNN (STIFFNESS APPROACH)

1. ELEMENT STIFFNESS MATRICES
2. MEMBER PROPERTIES (INCLUDING GAGES)
3. STRUCTURAL STIFFNESS MATRIX
4. RIGID BODY MODE DEFLECTIONS AT STRUCTURES NODES.

SOTOFO.PNN (FLEXIBILITY APPROACH)

1. ELEMENT STIFFNESS MATRICES
2. MEMBER PROPERTIES (INCLUDING GAGES)
3. TRANSFORMATION MATRIX RELATING APPLIED FORCES AT DYNAMICS MODEL NODE POINTS TO DISPLACEMENTS AT STRUCTURES MODEL NODE POINTS.
4. DYNAMICS MODEL FLEXIBILITY MATRIX
5. RIGID BODY MODE DEFLECTIONS AT STRUCTURES NODES.
6. RIGID BODY MODE DEFLECTIONS AT DYNAMICS NODES.

III. SOTOSO.PNN

THIS NAME IDENTIFIES AN ADDITIONAL DATA SET GENERATED BY THE ASAM/ASOM MODULE OF SOP AND STORED ON DSIO UNIT NUMBER 1. AS ITS NAME IMPLIES, THE SOTOSO TAPE IS USED AS INPUT TO SOP IN A SUBSEQUENT PASS, WHEN FURTHER STRENGTH ANALYSIS/REDESIGN IS REQUIRED. THUS, IN THE INITIAL EXECUTION OF SOP, A SOTOSO TAPE IS GENERATED AND IN ALL SUBSEQUENT PASSES SOTOSO TAPES WILL BE SPECIFIED AS BOTH INPUT TO AND OUTPUT FROM SOP. FOR EXAMPLE, IN THE THIRD PASS THROUGH SOP, THE INPUT TAPE WILL BE SOTOSO.P02 MOUNTED ON UNIT NUMBER 8, AND THE OUTPUT TAPE WILL BE SOTOSO.P03 ON UNIT NUMBER 1. THE SPECIFIC DATA FILES AND DESCRIPTIONS FOLLOW.

SOTOSO.PNN (STIFFNESS APPROACH)
----

1. GEOMETRY OF STRUCTURES MODEL NODE POINTS.
2. BOUNDARY CONDITIONS
3. APPLIED LOADS
4. MEMBER PROPERTIES

SOTOSO.PNN (FLEXIBILITY APPROACH)
----

1. GEOMETRY OF STRUCTURES MODEL NODE POINTS.
2. BOUNDARY CONDITIONS
3. APPLIED LOADS
4. MEMBER PROPERTIES
5. TRANSFORMATION MATRIX RELATING UNIT FORCES APPLIED AT DYNAMICS MODEL NODE POINTS TO FORCES AT STRUCTURES MODEL NODE POINTS.

THE DATA ON THE FIRST TWO FILES OF THE SOTOSO TAPE DEFINE THE TOPOLOGY OF THE FINITE ELEMENT STRUCTURES MODEL. THE APPLIED LOADS, ON FILE 3, ARE THE DESIGN LOADS CALCULATED IN THE ALAM MODULE (PLUS ANY ADDITIONAL LOAD CONDITIONS ENTERED ON CARDS IN ASAM) AND BEAMED TO THE STRUCTURES MODEL NODE POINTS. THE MEMBER PROPERTIES DATA, ON FILE 4, DEFINE THE CHARACTERISTICS OF EACH FINITE ELEMENT IN THE STRUCTURES MODEL INCLUDING ITS CURRENT GAGE SIZE AND ITS MINIMUM ALLOWABLE GAGE SIZE. IT IS NOTED THAT IN THE FIRST PASS THROUGH SOP THE MINIMUM ALLOWABLE GAGE ON THE OUTPUT SOTOSO UNIT WILL BE THE MINIMUM MANUFACTURING GAGE SPECIFIED BY THE USER, AND THE CURRENT GAGE WILL BE DICTATED BY STRENGTH OR MINIMUM MANUFACTURING GAGE REQUIREMENTS, WHICHEVER IS LARGER.

AS INDICATED ABOVE, AN ADDITIONAL FILE (5) IS GENERATED ON THE SOTOSO TAPE WHEN USING THE 'FLEXIBILITY APPROACH'. THIS FILE CONTAINS THE FORCE BEAMING TRANSFORMATION MATRIX REQUIRED TO CALCULATE THE DYNAMICS MODEL FLEXIBILITY MATRIX IN ASAM.

THE SUBSEQUENT USE OF A SOTOSO TAPE AS INPUT TO SOP WILL BE DEFERRED UNTIL THE FLUTTER OPTIMIZATION PROGRAM (FOP) HAS BEEN REVIEWED.

FOP OVERVIEW AND DEFINITION OF PROGRAM INPUT/OUTPUT UNITS

THE FASTOP MODULAR FLOW CHART SHOWN IN FIGURE 1 PROVIDES THE TOTAL RELATIONSHIP OF THE TWO MAJOR PROGRAMS AND THEIR ASSOCIATED MODULES. A SIMPLIFIED MODULAR CHART OF THE PHYSICAL STRUCTURE OF THE MAIN PROGRAM AND ASSOCIATED MODULES FOR FOP IS

SHOWN IN FIGURE 6.

SUBSEQUENT TO THE FOP EXECUTION, A MULTI-STEP EXECUTION MAY BE INITIATED BY ENTERING THE SOP SYSTEM. FOR DETAILS OF THE SOP EXECUTION SEE SECTION TITLED 'SOP OVERVIEW AND DEFINITION OF PROGRAM INPUT/OUTPUT UNITS' AND PART B.

THE FUNCTION OF EACH FOP MODULE IS BRIEFLY SUMMARIZED IN FIGURES 7 TO 9. COMMUNICATION FROM SOP TO FOP IS ACCOMPLISHED VIA THE SOTOFO TAPE DESCRIBED PREVIOUSLY. THIS DATA-SET, WHICH WAS GENERATED ON UNIT 9 IN SOP IS INPUT TO FOP ON UNIT 5. DATA GENERATED BY THE VARIOUS FOP MODULES CAN BE SAVED ON DISKS AND/OR TAPES. THESE DATA ARE ASSIGNED ONE OF THE FOLLOWING DATA-SET NAMES

VIBRAT.PNN
AIC
PLOT.PNN
FOTOFO.PNN
FOTOSO.PNN

THE FUNCTION OF EACH OF THESE DATA-SETS AND THE INFORMATION CONTAINED IN THEM ARE DESCRIBED BELOW.

I. VIBRAT.PNN

THIS DATA-SET CONSISTS OF ONE FILE CONTAINING FREQUENCIES, GENERALIZED MASSES, AND MODE SHAPES OF THE NORMAL MODES CALCULATED IN AVAM. THE DATA ARE STORED ON UNIT 17. (THIS UNIT 17 DIFFERS FROM THE SOP.UNIT17 DISCUSSED PREVIOUSLY.) THE VIBRATION DATA ON UNIT 17 MAY BE USED SUBSEQUENTLY AS INPUT TO AFAM FOR FLUTTER SPEED COMPUTATIONS. HOWEVER IF FLUTTER REDESIGN IS TO BE ACCOMPLISHED, THE MODAL DATA MUST BE COMPUTED DIRECTLY IN AVAM. THAT IS, NO FLUTTER REDESIGN CAN BE ACCOMPLISHED USING SAVED MODAL DATA.

II. AIC

THE DATA-SET AIC CONTAINS THE AERODYNAMIC INFLUENCE COEFFICIENT MATRICES COMPUTED IN THE FLUTTER ANALYSIS MODULE, AFAM. THE DATA MAY BE SAVED ON UNIT 31 FOR ANY OF THE THREE UNSTEADY AERODYNAMIC FLOW THEORIES AVAILABLE TO THE USER, I.E., MACH-BOX, ASSUMED-PRESSURE-FUNCTION, AND DOUBLET LATTICE. THE SAVED AIC'S ARE READ FROM UNIT 31 IN ANY SUBSEQUENT FLUTTER ANALYSIS. IN THE CASE OF MACH-BOX AND ASSUMED-PRESSURE-FUNCTION ROUTINES, THE SAVED DATA CONSIST OF ONE FILE, WHEREAS THE DOUBLET LATTICE ROUTINE GENERATES AS MANY FILES AS THE NUMBER OF REDUCED FREQUENCIES FOR WHICH AERODYNAMIC INFLUENCE COEFFICIENTS HAVE BEEN COMPUTED.

III. PLOT.PNN

SINCE THIS DATA-SET CONTAINS INFORMATION FOR CALCOMP PLOTS, THE UNIT DESIGNATION WILL BE A FUNCTION OF THE OPERATING SYSTEM. PLOTS MAY BE OBTAINED OF VIBRATION MODE SHAPES OR THE DAMPING AND FREQUENCY OF THE FLUTTER ROOTS VERSUS AIRSPEED.

IV. FOTOFO.PNN

AS ITS NAME IMPLIES, THE FOTOFO DATA-SET CONTAINS INFORMATION GENERATED AS OUTPUT DATA FROM THE FLUTTER OPTIMIZATION PROGRAM AND USED IN A SUBSEQUENT PASS WHEN FURTHER FLUTTER REDESIGN IS REQUIRED. THUS, IN THE INITIAL EXECUTION OF FOP, A FOTOFO TAPE IS GENERATED WHEREAS IN ALL SUBSEQUENT PASSES FOTOFO TAPES WILL BE SPECIFIED AS BOTH INPUT TO AND OUTPUT FROM THE FOP PROGRAM. THE INPUT AND OUTPUT UNITS FOR THIS DATA ARE 8 AND 7 RESPECTIVELY. THE NUMBER OF DATA FILES ON THE FOTOFO UNIT IS OPTION-DEPENDENT WITH A MAXIMUM NUMBER OF EIGHT. THE INFORMATION CONTAINED ON THESE FILES IS DESCRIBED BELOW.

1. ELEMENT STIFFNESS MATRICES (COPIED FROM SOTOFO UNIT)
2. INITIAL (USER SUPPLIED) MASS DATA FOR VIBRATION ANALYSIS
3. PLUG MASS
4. RIGID BODY MODE DEFLECTIONS AT STRUCTURES NODES
5. RIGID BODY MODE DEFLECTIONS AT DYNAMICS NODES
6. MASS BALANCE DATA
7. FINAL DESIGN ARRAY
8. WEIGHT DATA

THE ELEMENT STIFFNESS MATRIX, ON FILE 1, IS USED TO COMPUTE BOTH FLUTTER-VELOCITY DERIVATIVES AND THE INCREMENTAL STIFFNESS MATRIX DUE TO FLUTTER-REDESIGN. THE SECOND FILE CONTAINS EITHER THE INITIAL USER-SUPPLIED DYNAMICS (VIBRATION) MODEL MASS MATRIX, OR THE FIXED-MASS ADDITIONS WHEN USING THE FULLY-AUTOMATED MASS MATRIX GENERATOR OPTION. THIS DATA WILL BE STORED ON THE FOTOFO UNIT IN THE INITIAL PASS THROUGH FOP. IF THE FULLY-AUTOMATED MASS MATRIX GENERATOR OPTION IS USED WITHOUT FIXED-MASS ADDITIONS, THEN THIS FILE WILL BE ELIMINATED. FILES 3, 4, AND 5 ARE REQUIRED TO COMPUTE FREE FREE MODES OF VIBRATION IN AVAM. FILE 5 IS ELIMINATED IF THE 'STIFFNESS APPROACH' IS USED AND ALL THREE FILES ARE ELIMINATED IF VIBRATION MODES ARE TO BE CALCULATED FOR A CANTILEVER STRUCTURES MODEL. THE MASS BALANCE DATA, ON FILE 6, CONTAINS INFORMATIONON ON THE LOCATION, INITIAL VALUES, CURRENT VALUES, ETC., OF MASS BALANCE DESIGN VARIABLES. THIS FILE IS ELIMINATED IF THE PROGRAM USER DOES NOT WISH TO CONSIDER MASS BALANCE VARIABLES IN ACCOMPLISHING FLUTTER REDESIGN. FILE 7 CONTAINS DATA PERTAINING TO ALL STRUCTURAL ELEMENTS DESIGNATED AS FLUTTER-REDESIGN VARIABLES. THESE DATA INCLUDE INITIAL AND CURRENT GAGES AND ELEMENT WEIGHT PER UNIT GAGE ADJUSTED BY USER-SPECIFIED NON-OPTIMUM FACTORS. THE WEIGHT DATA FILE IS USED EXCLUSIVELY FOR WEIGHT ACCOUNTING THROUGHOUT

THE REDESIGN PROCESS AND INCLUDES INFORMATION REQUIRED TO CALCULATE INCREMENTAL AND ACCUMULATIVE WEIGHT CHANGES THAT OCCUR IN BOTH SOP AND FOP.

V. FOTOSO.PNN

AFTER FLUTTER RESIZING IN FOP, THE FINAL GAGES OF EVERY ELEMENT IN THE STRUCTURES MODEL ARE STORED AS A SINGLE FILE ON UNIT 6. THESE 'MEMBER PROPERTIES' DATA, DESIGNATED AS FOTOSO, ARE USED AS INPUT TO SOP FOR FURTHER STRENGTH ANALYSIS/REDESIGN.

SUBSEQUENT ENTRIES INTO SOP AND FOP

THE DISCUSSION, TO THIS POINT, HAS BEEN PRIMARILY ASSOCIATED WITH THE INPUT AND OUTPUT UNITS REQUIRED FOR AN INITIAL EXECUTION OF THE SOP AND FOP PROGRAMS, I.E. THE FIRST CYCLE OF COMBINED STRENGTH/FLUTTER REDESIGN. A SECOND CYCLE OF REDESIGN IS INITIATED BY REENTERING SOP WITH THE FOREMENTIONED FOTOSO TAPE AS INPUT DATA ON UNIT 10 AND THE SOTOSO TAPE GENERATED IN THE PREVIOUS PASS THROUGH SOP, WHICH IS NOW ENTERED ON UNIT 8. THE PROGRAM THEN UPDATES THE MEMBER DATA ON FILE 4 OF THE SOTOSO TAPE, WHICH WAS OUTPUT FROM THE PREVIOUS STRENGTH ANALYSIS, WITH THE GAGES FROM THE SUBSEQUENT FLUTTER REDESIGN WHICH ARE ON THE FOTOSO TAPE. FROM THIS POINT, REDESIGN IN SOP AND FOP PROCEEDS AS DESCRIBED PREVIOUSLY.

CARD DATA FLOW OF SOP-FOP AND ASSOCIATED MODULES

THUS FAR THE DISCUSSION HAS CENTERED AROUND THE FASTOP OVERVIEW AND THE DEFINITION OF INPUT/OUTPUT UNITS WITHOUT ANY SPECIFIC REFERENCES TO CARD INPUT DATA. TO AID THE USER IN EXECUTING THIS PROGRAM, FIGURES 12 AND 13 SUMMARIZE THE DATA NEEDED FOR THE SOP-FOP MAIN PROGRAMS AND ASSOCIATED MODULES. PART OF THE DATA IN THE MAIN PROGRAMS ARE CLUES TO SELECT WHICH OF THE MODULES ARE TO BE EXECUTED IN A CURRENT RUN. IN A SOP RUN FOR ANALYSES ONLY, CLUES KLUE(1), KLUE(2), AND KLUE(5) MUST BE TURNED ON IF ALL THREE ANALYSES MODULES (LOAD, STRENGTH, AND TRANSFORMATION) ARE TO BE EXECUTED. FOR STRENGTH OPTIMIZATION IN ADDITION TO THE THREE ANALYSES CLUES, THE OPTIMIZATION CLUE, KLUE(6), MUST ALSO BE TURNED ON. IN A FOP RUN, CLUES KLUE(3) AND KLUE(4), WHICH ARE ASSOCIATED WITH VIBRATION AND FLUTTER ANALYSES, MUST BE TURNED ON TO EXECUTE THESE TWO MODULES IN SEQUENCE IN THE CURRENT RUN. FOR FLUTTER OPTIMIZATION, AN ADDITIONAL CLUE, KLUE(7), MUST ALSO BE TURNED ON. NOTE THAT

CARD DATA FOR THE MAIN PROGRAMS IN EITHER SOP OR FOP MUST ALWAYS BE ENTERED WHEREAS THE ADDITIONAL DATA DEPENDS UPON THE MODULES BEING EXECUTED.

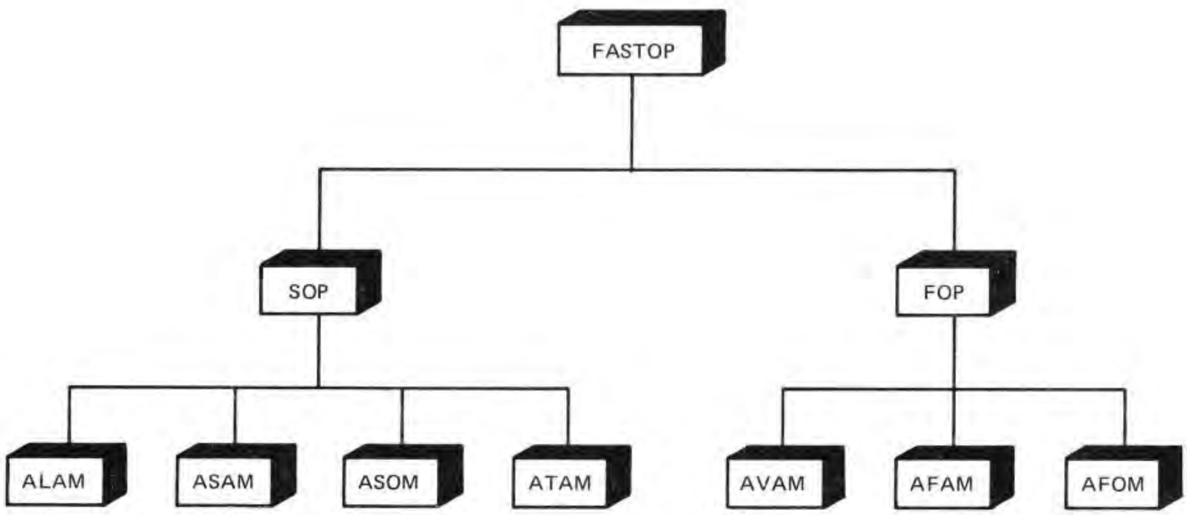


Figure 1 FASTOP Modular Flow Chart

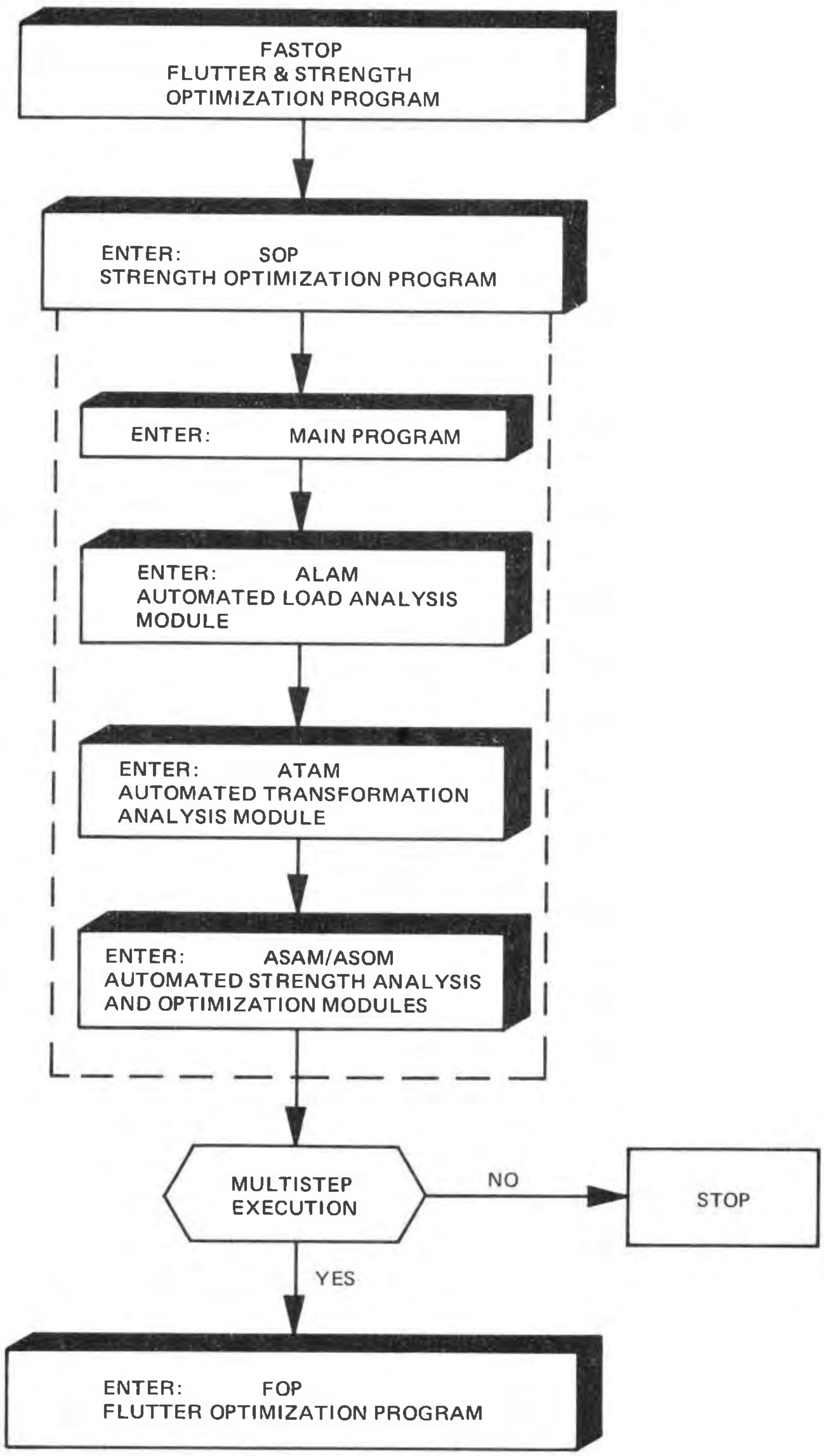


Figure 2 SOP Modular Flow Chart in FASTOP

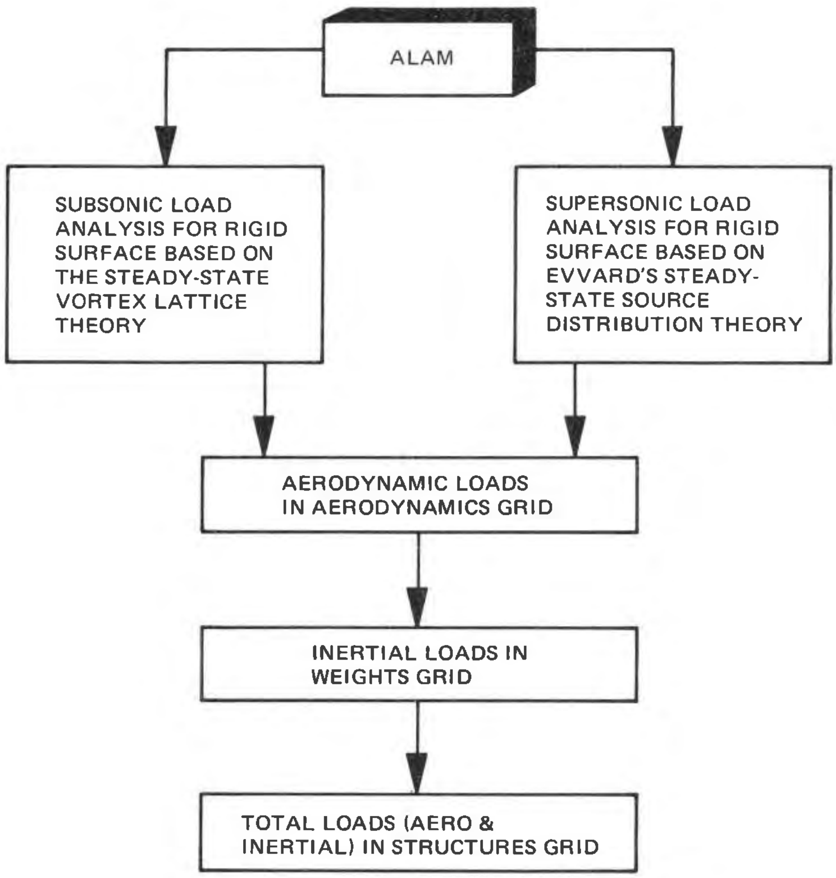


Figure 3 ALAM-Automated Load Analysis Module

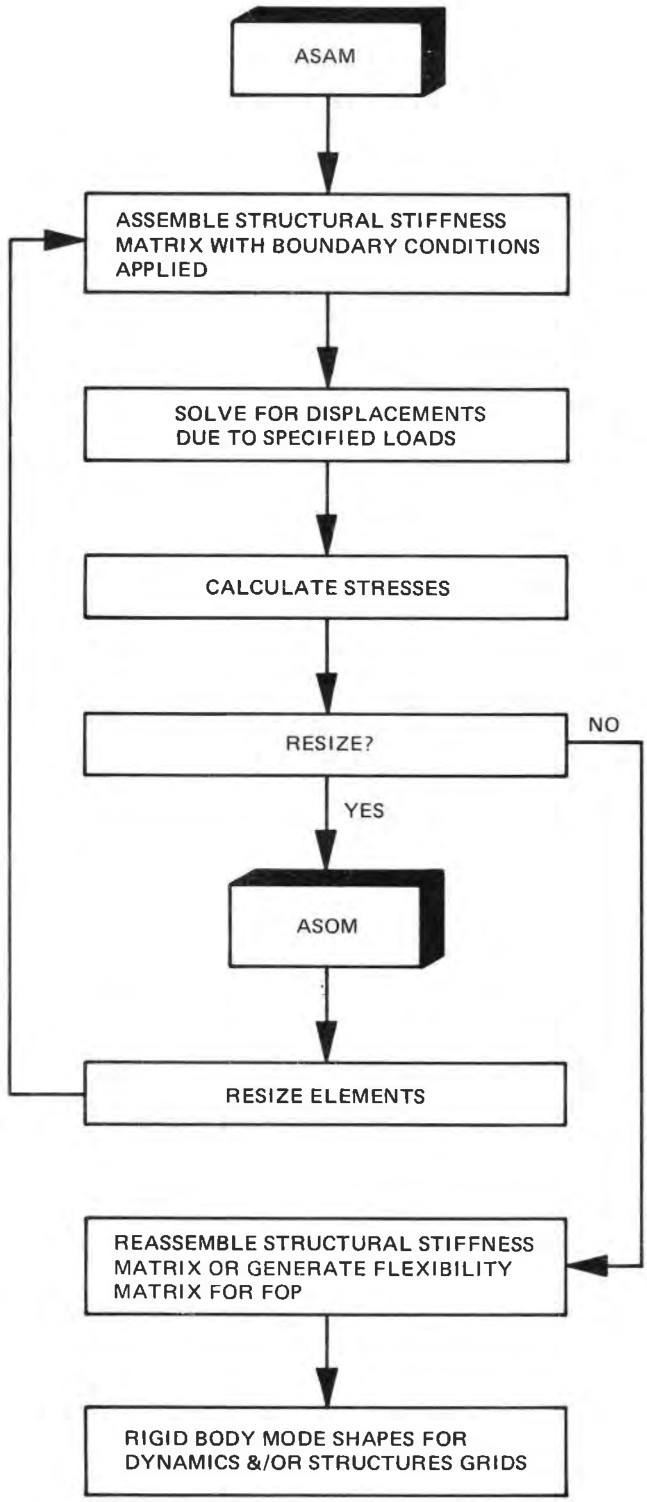


Figure 4 ASAM/ASOM-Automated Strength Analysis and Optimization Modules

FASTOP—OVERVIEW

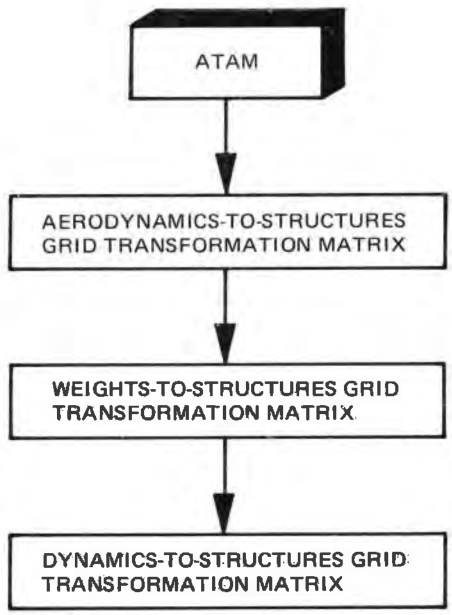


Figure 5 ATAM-Automated Transformation Analysis Module

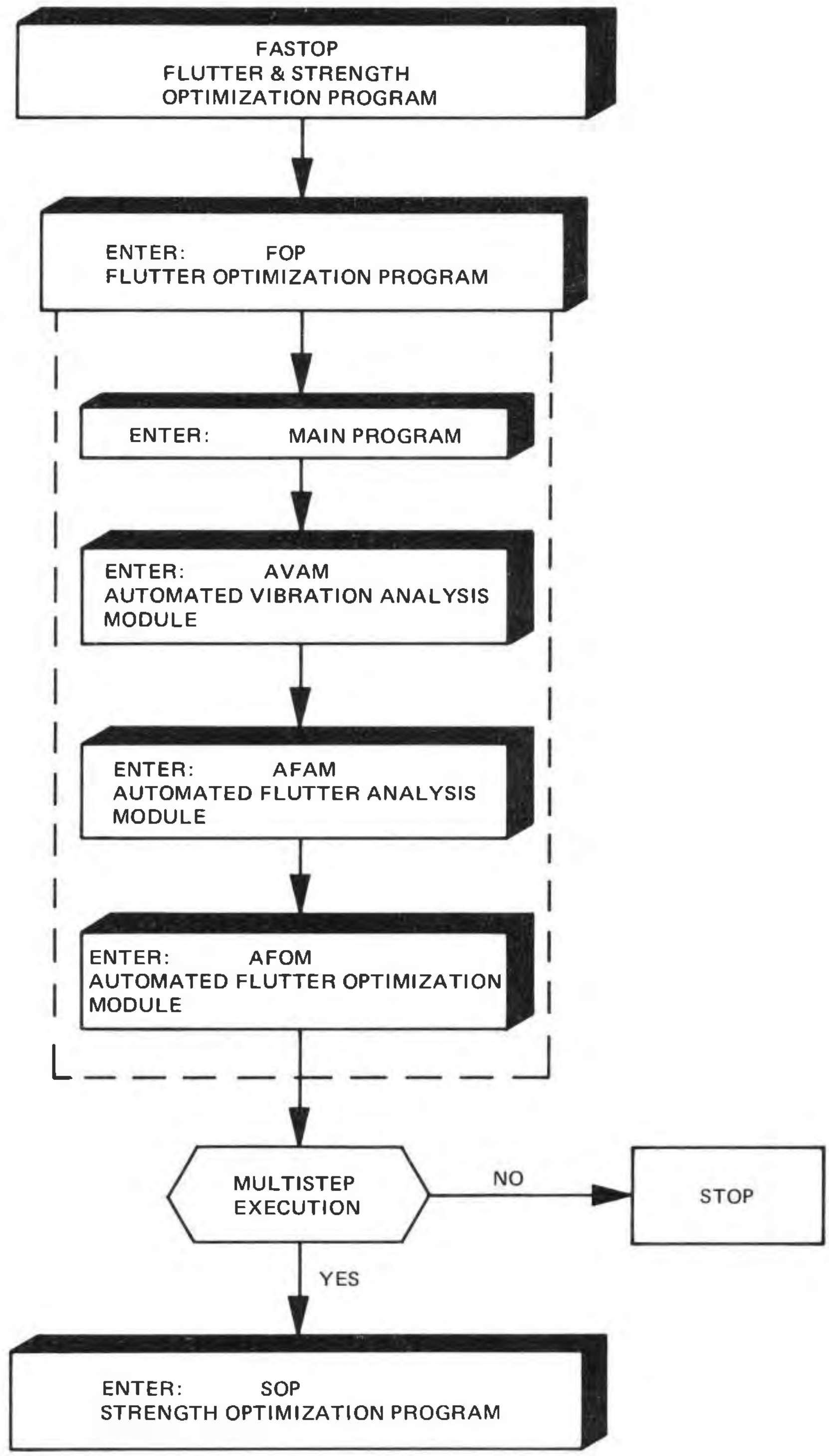


Figure 6 FOP Modular Flow Chart in FASTOP

FASTOP–OVERVIEW

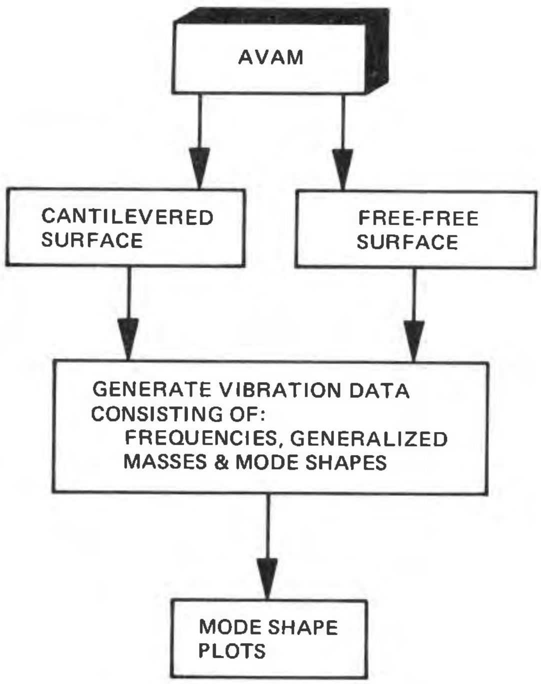


Figure 7 AVAM-Automated Vibration Analysis Module

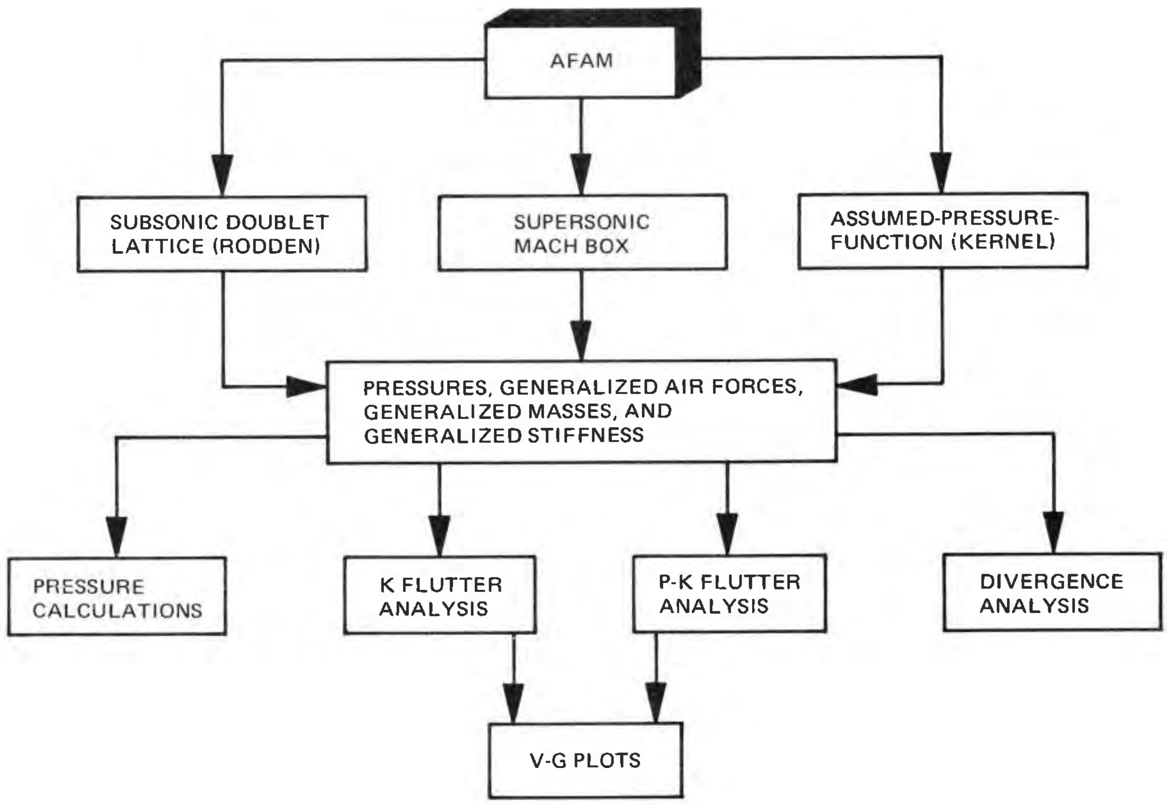


Figure 8 AFAM-Automated Flutter Analysis Module

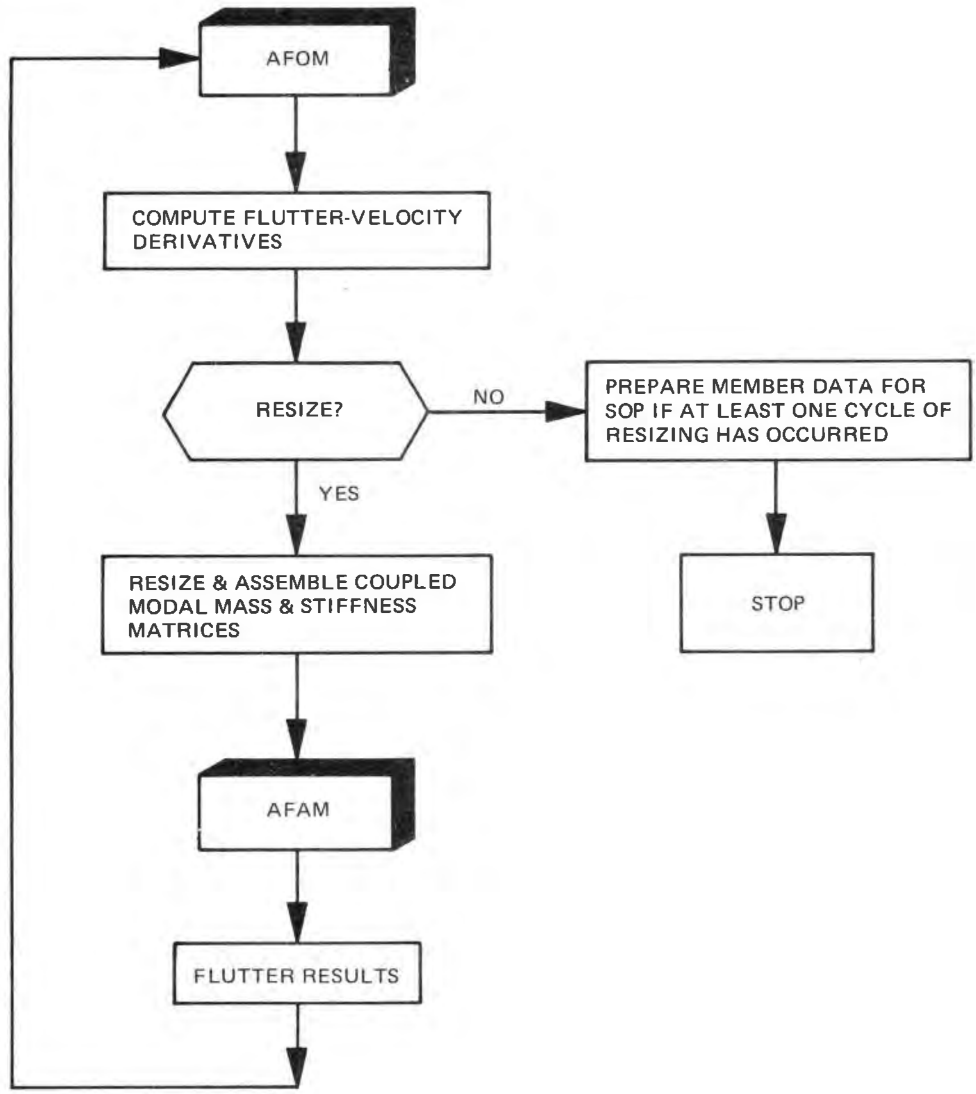


Figure 9 AFOM-Automated Flutter Optimization Module

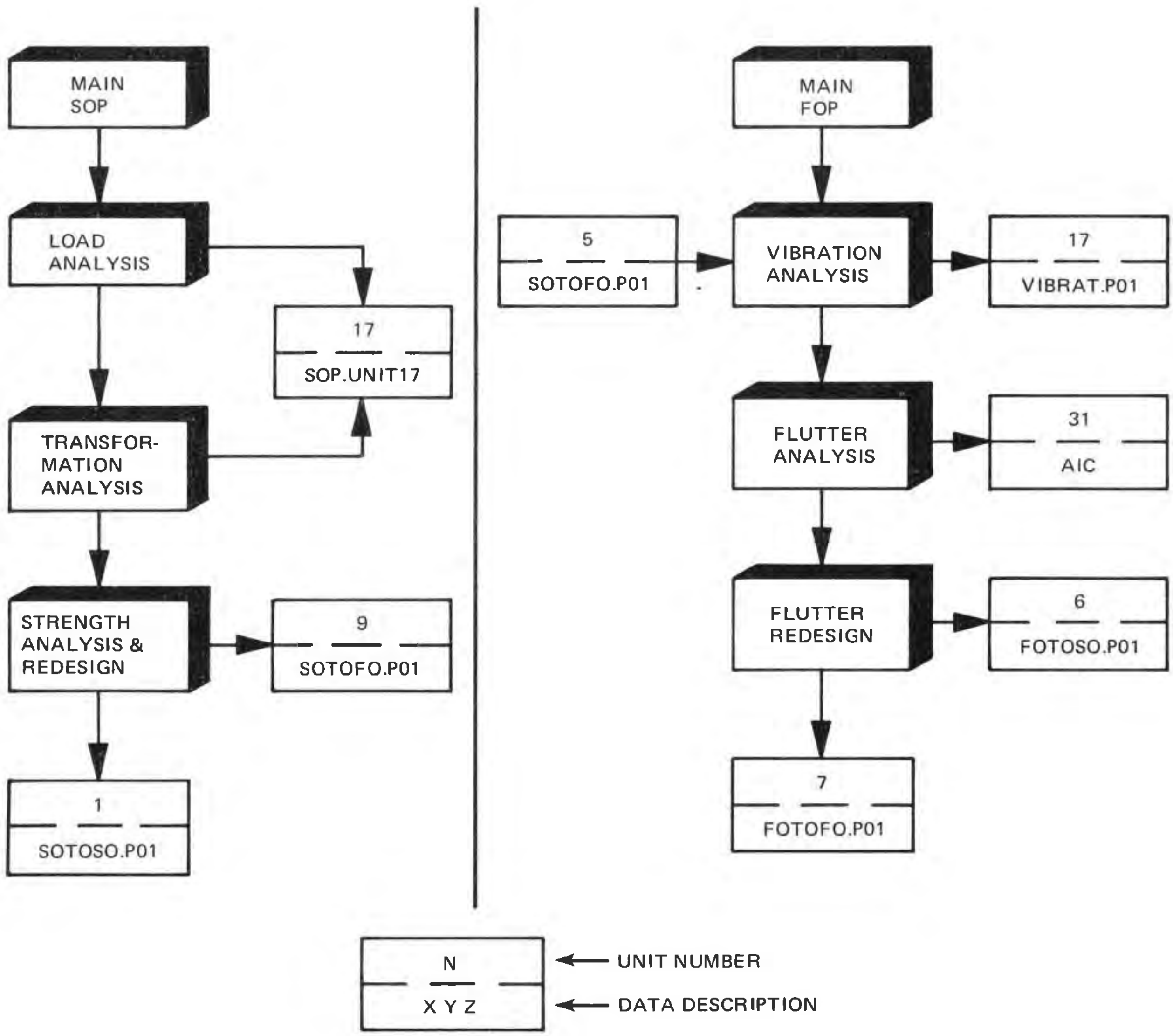


Figure 10 Relationship of Input/Output Units in a First Pass for SOP and FOP

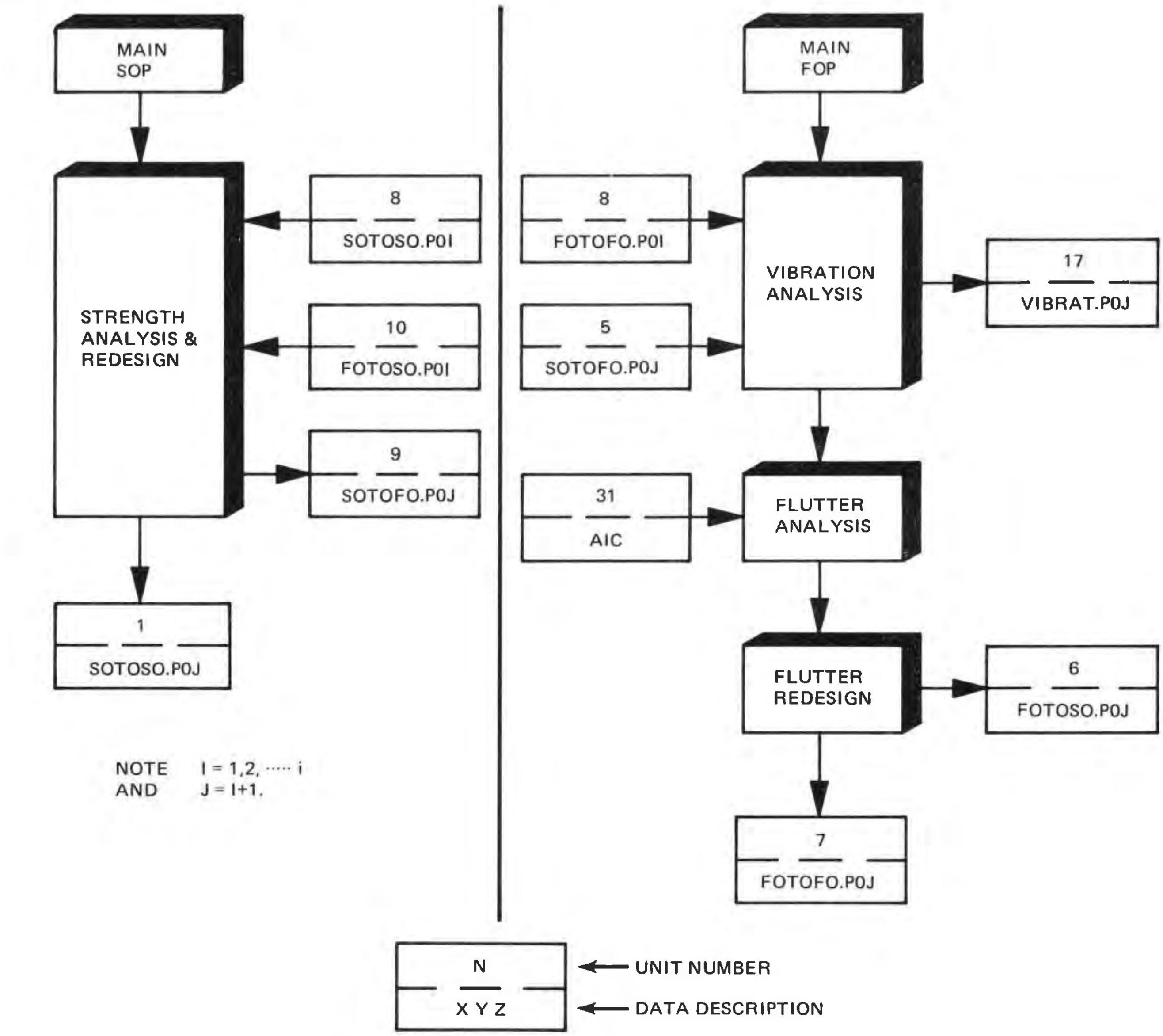
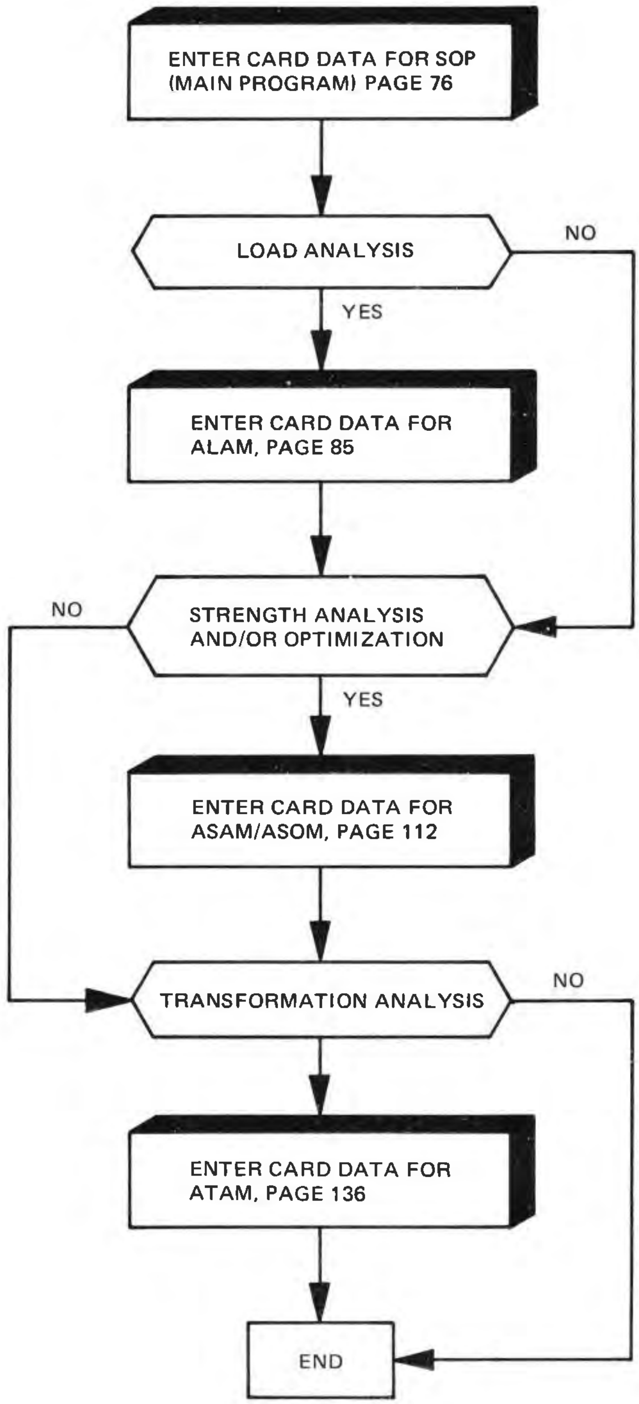
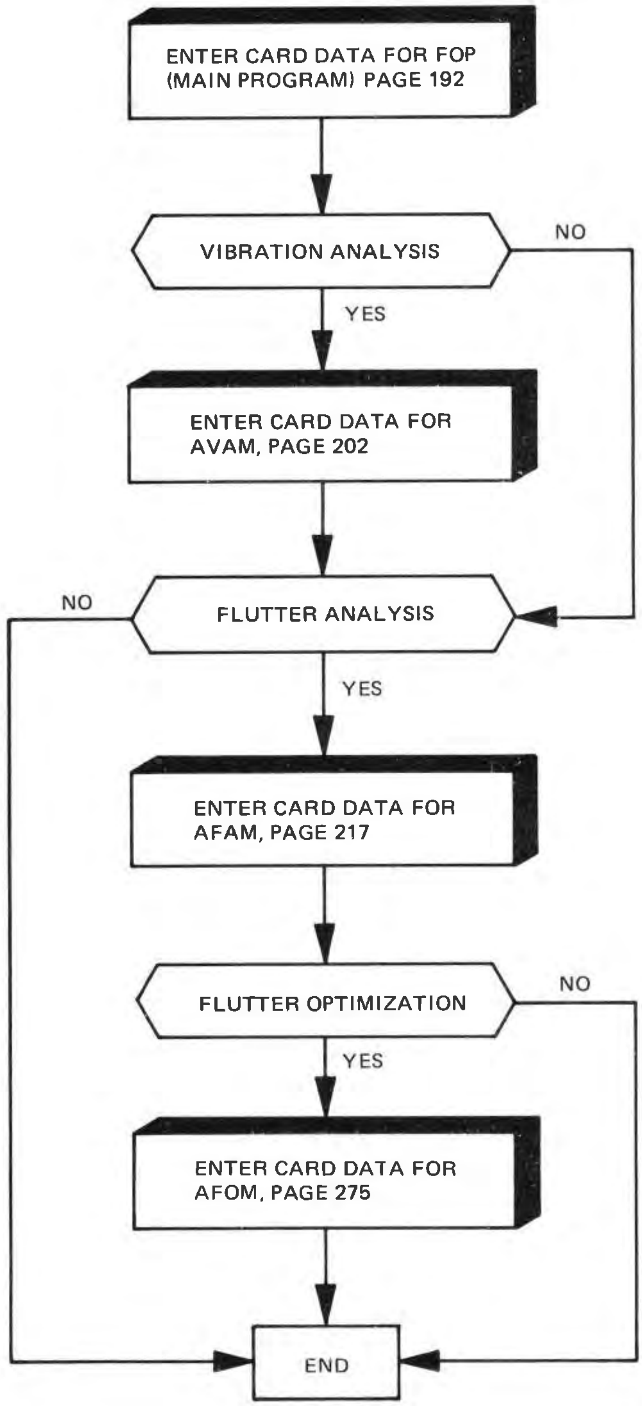


Figure 11 Relationship of Input/Output Units in a Subsequent J^{th} Pass for SOP and FOP



NOTE: PAGE NUMBERS REFER TO PART B

Figure 12 Card Data Flow of SOP and Associated Modules



NOTE: PAGE NUMBERS REFER TO PART C

Figure 13 Card Data Flow of FOP and Associated Modules

PART B

USAGE/INPUT/OUTPUT FOR STRUCTURAL OPTIMIZATION PROGRAM (SOP)

USAGE

MAIN PROGRAM (SOP)

I. PROGRAM APPLICATION

A. FORMATS

THE FORMATS USED FOR INPUT DATA TO THE PROGRAM DESCRIBED HEREIN ARE EXPLAINED BRIEFLY BELOW. IN GENERAL, THE VALUE OF THE VARIABLE IS PUNCHED FIRST ON A CARD, AND THE REMAINING COLUMNS MAY BE USED TO IDENTIFY THE VARIABLE BY MEANS OF EITHER FORTRAN SYMBOLS OR A WORD DESCRIPTION.

A FORMAT 1E12.3 INDICATES THAT THE VARIABLE IS USUALLY KEYPUNCHED IN COLUMNS 3-12 OF THE CARD (RIGHT JUSTIFIED) IN THE FOLLOWING MANNER. -X.XXXE-YY, WHERE THE NUMBER IS -X.XXX TIMES 10**-YY. IF MORE DIGITS ARE REQUIRED THE NUMBER MAY BE PUNCHED ON THE CARD AS -X.XXXXXE-YY, -X.XXXXXXE-Y, OR -X.XXXXXXX-Y. A FORMAT 2E12.3, INDICATES THAT THE VALUES OF TWO VARIABLES ARE TO BE PUNCHED ON THE SAME CARD. THE FIRST IN COLUMNS 3-12 AND THE SECOND IN COLUMNS 15-24.

A FORMAT F10.3 INDICATES THAT THE VARIABLE IS USUALLY PUNCHED IN COLUMNS 3-10 OF THE CARD AS FOLLOWS -XXX.XXX.

A FORMAT I4 INDICATES THAT AN INTEGER OF FOUR OR LESS DIGITS IN COLUMNS 1-4 IS PUNCHED WITH THE UNITS DIGIT ALWAYS AT THE EXTREME RIGHT OF THE FIELD. A GENERALIZATION OF THIS FORMAT, KI4, WHERE K IS ASSIGNED ANY VALUE BETWEEN TWO AND EIGHTEEN, DENOTES K GROUPS OF A MAXIMUM OF FOUR INTEGERS EACH IN COLUMNS, 1-4, 5-8,...., 69-72, RESPECTIVELY.

THE FORMAT 72H REFERS TO CARDS OF IDENTIFICATION (TITLES), AND INDICATES THAT ANY ALPHAMERIC CHARACTER MAY BE PUNCHED IN COLUMNS 1-72.

A COMBINED FORMAT SUCH AS 1E12.3, 60H DENOTES THAT THE VARIABLE IN THE FIRST 12 COLUMNS IS TO BE FOLLOWED BY UP TO 60 COLUMNS OF ALPHAMERIC CHARACTERS. A FORMAT 2X IN THE MIDDLE OF THIS COMBINED FORMAT, PROVIDES FOR TWO BLANK SPACES BETWEEN THE NUMBER AND ITS DESCRIPTION.

FINALLY, A FORMAT A4 IS USED TO STORE ALPHAMERIC INFORMATION IN FORTRAN VARIABLES IN THE FORM OF FOUR CHARACTERS PER WORD. THIS FORMAT IS USED FOR WRITING AND/OR PLOTTING CERTAIN ALPHAMERIC INFORMATION.

B. ARRANGEMENT OF DATA ON CARDS

THE INPUT DATA TO BE ENTERED ON CARDS ARE DESCRIBED IN CONSECUTIVELY NUMBERED GROUPS CALLED 'ITEMS'. ALL THE VARIABLES SUMMARIZED UNDER THE SAME ITEM ARE PUNCHED CONSECUTIVELY ON THE SAME CARD OR GROUP OF CARDS USING THE INDICATED FORMAT. IN THE CASE OF SUBSCRIPTED VARIABLES THE INSTRUCTIONS 'REPEAT' AND 'ENTER' ARE USED WITH THE ASSOCIATED INDICES TO INDICATE THE ORDER IN WHICH THE INPUT DATA IS PUNCHED ON CARDS. THE INSTRUCTION 'REPEAT' REQUIRES ANOTHER CARD OR GROUP OF CARDS FOR EACH COMBINATION OF INDICES, WHEREAS THE INSTRUCTION 'ENTER' INDICATES THAT THE VALUES OF THE VARIABLES ARE PUNCHED ON THE SAME CARD AND ANY CONTINUATION CARDS REQUIRED TO COVER THE INDICATED RANGE OF INDICES. THESE TWO INSTRUCTIONS MAY BE REPEATED A NUMBER OF TIMES, WITH THE TOPMOST INSTRUCTION DESIGNATING THE STEP TO BE EXECUTED LAST. FOR EXAMPLE, THE FOLLOWING COMBINATION OF TWO INSTRUCTIONS AND ASSOCIATED FORMAT,

```
        REPEAT THE FOLLOWING ITEM FOR I = 1,...., IMAX(=2),
        REPEAT THE FOLLOWING ITEM FOR J = 1,...., JMAX(=3), AND
        ENTER (FOUR VALUES OR LESS PER  ARD) FOR K = 1,....,KMAX(=3)


X.  *** A(I,J,K) (DEFINITION)
    *
    *** B(I,J,K) (DEFINITION)
        ------------------------------------------------
        |00000000011111111112222222222333333333344444444445|
        |12345678901234567890123456789012345678901234567890|
        |---------|---------|---------|---------|----------|
        |   . E   |   . E   |   . E   |   . E   | A, B(I,J,K)|
        ------------------------------------------------

        FORMAT = (4E9.2).  NUMBER OF CARDS IS
        IMAX * JMAX * ((KMAX -1)/2 + 1) (=12).
```

WILL REQUIRE THE INPUT DATA PUNCHED ON CARDS AS FOLLOWS

. E	. E	. E	. E	A, B(1,1,K), K=1,2
. E	. E			A, B(1,1,K), K=3,3
. E	. E	. E	. E	A, B(1,2,K), K=1,2
. E	. E			A, B(1,2,K), K=3,3
. E	. E	. E	. E	A, B(1,3,K), K=1,2
. E	. E			A, B(1,3,K), K=3,3
. E	. E	. E	. E	A, B(2,1,K), K=1,2
. E	. E			A, B(2,1,K), K=3,3
. E	. E	. E	. E	A, B(2,2,K), K=1,2
. E	. E			A, B(2,2,K), K=3,3
. E	. E	. E	. E	A, B(2,3,K), K=1,2
. E	. E			A, B(2,3,K), K=3,3

MORE SPECIFICALLY THE FIRST DATA CARD CONSISTS OF A(1,1,1), B(1,1,1), A(1,1,2), AND B(1,1,2), AND THE TWELFTH CARD CONTAINS A(2,3,3) AND B(2,3,3).

SINCE INTEGER DIVISION TRUNCATES A QUOTIENT HAVING A FRACTIONAL PART TO THE NEXT SMALLER INTEGER, THE FRACTION (KMAX-1)/2 IS TO BE INTERPRETED AS THE 'LOWEST INTEGER VALUE'. THUS, IF KMAX WERE EQUAL TO 4 INSTEAD OF 3 AS IN THE ABOVE EXAMPLE, IMAX*JMAX*((KMAX-1)/2 + 1) WOULD STILL BE EQUAL TO 12, SINCE ((KMAX-1)/2 + 1) = 1.5 + 1 = 1 + 1 = 2.

ALAM - AUTOMATED LOAD ANALYSIS MODULE

I. PROGRAM APPLICATION

THE LOAD ANALYSIS PROCEDURES EMPLOYED IN AN AIRPLANE DETAIL DESIGN PHASE CAN BE QUITE COMPLEX INVOLVING, FOR EXAMPLE, UTILIZATION OF EXPERIMENTAL PRESSURE DISTRIBUTIONS AND NONLINEAR AERODYNAMIC DERIVATIVES. SUCH CONSIDERATIONS RESULT IN EXTENSIVE DATA MANIPULATION IN WHICH EXPERIENCE IS AN ESSENTIAL INGREDIENT. COMPUTERIZATION OF THIS PROCESS IS SUFFICIENTLY COMPLEX TO JUSTIFY AN EXTENSIVE DEVELOPMENT STUDY. THE CURRENT PROGRAM ADDRESSES AN AUTOMATED BUT LESS AMBITIOUS LOADS CAPABILITY WHICH CAN BE EMPLOYED IN PRELIMINARY DESIGN STUDIES AND EXTENDED AT A LATER DATE TO INCLUDE MORE SOPHISTICATED REFINEMENTS.

IT IS IMPOSSIBLE TO DECIDE, APRIORI, WHAT CONSTITUTES A REALISTIC COMBINATION OF FLIGHT CONDITIONS THAT SHOULD BE CONSIDERED IN DEFINING THE CRITICAL DESIGN LOADS FOR AN AERODYNAMIC SURFACE. CONSEQUENTLY, WE INTEND TO PRESERVE COMPLETE GENERALITY IN USER SPECIFICATION OF LOAD PARAMETERS FOR THOSE LOADS ANALYSIS PROGRAMS THAT ARE INCLUDED IN THE TOTAL ANALYSIS CAPABILITY. IT IS FELT THAT THIS DECISION WILL SERVE TO ENHANCE THE FUTURE GROWTH POTENTIAL OF THE LOADS ANALYSIS PROGRAMS.

THE LOADS PART OF THE ANALYSIS PROGRAMS INCLUDES TWO MAJOR SUB-MODULES, CALCULATION OF AERODYNAMIC FORCES AND CALCULATION OF INERTIAL FORCES. EACH OF THESE CALCULATIONS ARE SELF-CONTAINED AND EITHER CAN BE OMITTED IF SO DESIRED. PRIOR TO CALCULATING THE AERODYNAMIC LOADS IN THE AERODYNAMICS GRID, THE AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC AND/OR SUPERSONIC FLOW MUST BE FIRST CALCULATED. THESE TWO CALCULATIONS ARE DISCUSSED BELOW.

A. AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC FLOW

AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC LIFTING SURFACE ANALYSIS ARE BASED ON THE STEADY-STATE VORTEX LATTICE THEORY USING A DISTRIBUTION OF HORSESHOE VORTICES AND ASSOCIATED DOWNWASH POINTS. IN COMPUTING THESE AERODYNAMIC INFLUENCE COEFFICIENTS, ONLY THE DOWNWASH POINTS ON THE LEFT HAND SIDE OF THE WING ARE CONSIDERED. HOWEVER, THE CONTRIBUTIONS OF THE VORTICES ON BOTH SIDES OF THE WING ARE ACCOUNTED FOR IN COMPUTING THE SYMMETRIC AND/OR ANTISYMMETRIC INFLUENCE COEFFICIENTS.

FUSELAGE EFFECTS ON SURFACE LIFT ARE SIMULATED BY ASSUMING THAT THE HORSESHOE VORTICES ON THE WING HAVE IMAGES INSIDE THE FUSELAGE. THE FUSELAGE ITSELF IS ASSUMED TO BE AN INFINITE CYLINDER WITH A CONSTANT CROSS-SECTION. TO SATISFY THE BOUNDARY CONDITIONS ON THE FUSELAGE THE CONTRIBUTIONS OF THE WING HORSESHOE VORTICES ARE MODIFIED. IN ADDITION, THE ANGLE OF ATTACK ON THE WING IS CORRECTED TO ACCOUNT FOR THE PRESENCE OF THE FUSELAGE USING TWO-DIMENSIONAL THEORY.

ONCE CALCULATED THE AERODYNAMIC INFLUENCE COEFFICIENTS ARE STORED ON TAPE AND ARE EITHER USED DIRECTLY TO CALCULATE AERODYNAMIC FORCES FOR A GIVEN FLIGHT CONDITION OR SAVED FOR FUTURE USE.

B. AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUPERSONIC FLOW

AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUPERSONIC LIFTING SURFACE ANALYSIS ARE BASED ON EVVARD'S STEADY-STATE SOURCE DISTRIBUTION THEORY. IN COMPUTING THE AERODYNAMIC INFLUENCE COEFFICIENTS TWO GENERAL FLOW CONDITIONS ARE CONSIDERED, NAMELY, SUPERSONIC LEADING AND TRAILING EDGES AND SUBSONIC LEADING AND SUPERSONIC TRAILING EDGES. THESE TWO GENERAL FLOW CONDITIONS REQUIRE EVALUATING TWO DIFFERENT TYPES OF INTEGRAL EQUATIONS ACCORDING TO EVVARD'S PROCEDURE.

AS IN THE CASE OF SUBSONIC FLOW THE AERODYNAMIC INFLUENCE COEFFICIENTS ARE STORED ON TAPE.

C. INERTIAL LOADS

INERTIAL LOADS ARE CALCULATED IN THE WEIGHTS GRID USING THE SPECIFIED SURFACE MASS DISTRIBUTION AND THE LINEAR ACCELERATIONS AND ANGULAR VELOCITIES AND ACCELERATIONS FOR VARIOUS FLIGHT CONDITIONS. THESE LOADS ARE THEN CONVERTED TO THE STRUCTURES GRID THROUGH THE USE OF THE WEIGHTS GRID TRANSFORMATION MATRIX. AND STORED ON TAPE. THESE FORCES MAY BE USED BY THEMSELVES AS INPUT TO THE STRENGTH ANALYSIS PROGRAM, OR MAY BE COMBINED WITH THE AERODYNAMIC FORCES BEFORE THEY ARE PUT INTO THE STRENGTH ANALYSIS PROGRAM.

D. AERODYNAMIC LOADS

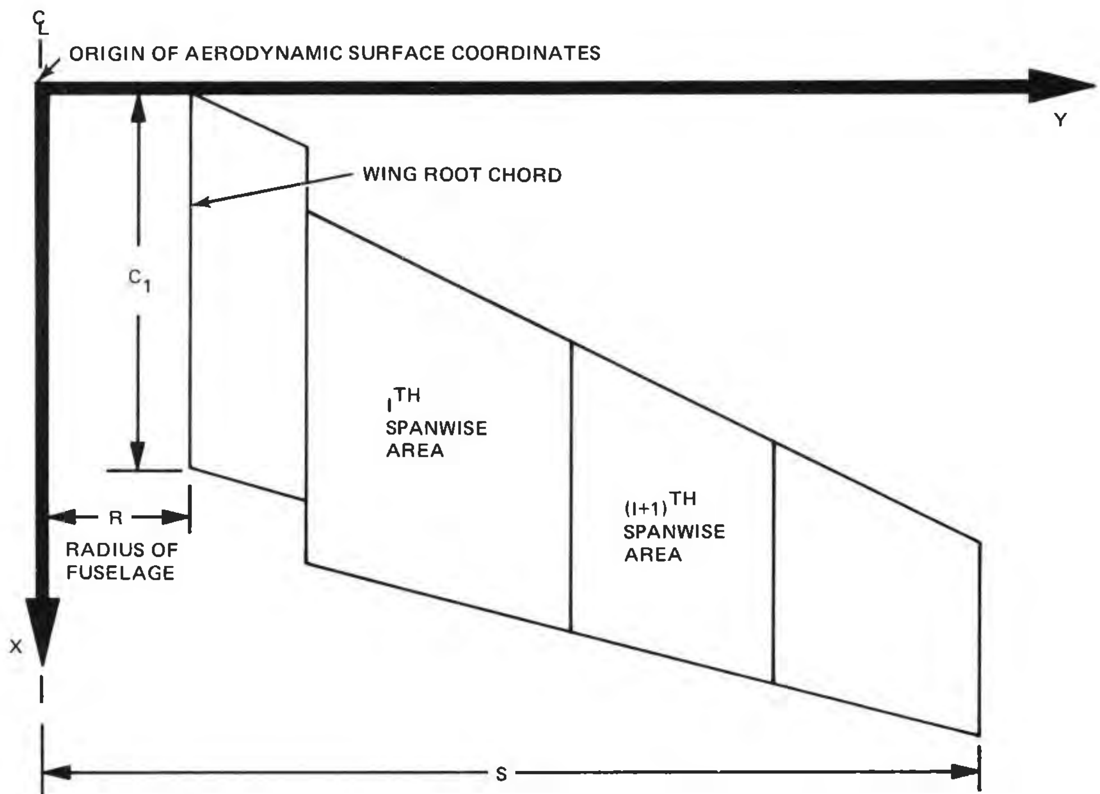
AERODYNAMIC LOADS ARE CALCULATED IN THE AERODYNAMICS GRID USING THE SUBSONIC AND/OR SUPERSONIC AERODYNAMIC INFLUENCE COEFFICIENTS SAVED ON TAPE FOR VARIOUS MACH NUMBERS AND UNIT

DYNAMIC PRESSURES.

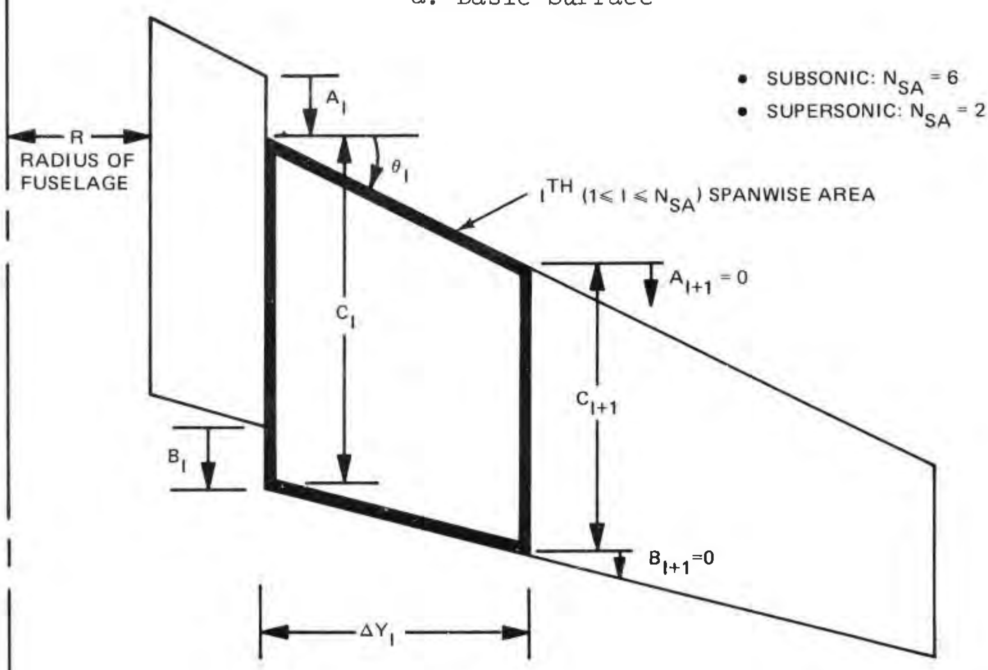
TO OBTAIN SURFACE AERODYNAMIC FORCES, THE PLANFORM IS SUBDIVIDED INTO AN ARBITRARY NUMBER OF SMALL PANELS (SEE FIGURES 1 AND 2) IN A FASHION DICTATED BY THE OVERALL PLANFORM GEOMETRY AND THE LOCATIONS OF THE CONTROL SURFACES. THE NUMBER OF PANELS IN THE CHORDWISE DIRECTION CAN VARY OVER THE SPAN. THE SAME PANEL GEOMETRY IS USED FOR ALL MACH NUMBERS.

TO COMPUTE AERODYNAMIC FORCES, ADDITIONAL INPUT DATA IS REQUIRED TO DESCRIBE AIRPLANE ATTITUDE. IT SHOULD BE REMEMBERED THAT THE ANGLE OF ATTACK CAN BE DIFFERENT FOR EACH PANEL, THEREFORE, THE COMPLETE SURFACE ANGLE OF ATTACK DISTRIBUTION IS DESCRIBED BY A VECTOR OF DIMENSION EQUAL TO THE NUMBER OF AERODYNAMIC PANELS. THE OUTPUT THEN IS A CORRESPONDING VECTOR OF CONCENTRATED AERODYNAMIC FORCES ACTING AT EACH PANEL. IF SEVERAL FLIGHT CONDITIONS ARE BEING CONSIDERED, THE VARIOUS ANGLES OF ATTACK AND FORCE VECTORS MAY BE REPRESENTED IN MATRIX FORM, WITH THE NUMBER OF ROWS EQUAL TO THE NUMBER OF PANELS AND THE NUMBER OF COLUMNS EQUAL TO THE NUMBER OF FLIGHT CONDITIONS.

THE LOADS IN THE AERODYNAMICS GRID ARE NEXT CONVERTED TO THE STRUCTURES GRID, THROUGH THE USE OF THE AERODYNAMICS GRID TRANSFORMATION MATRIX, AND STORED ON TAPE. THESE FORCES MAY BE USED DIRECTLY AS INPUT TO THE STRENGTH ANALYSIS PROGRAM OR MAY BE COMBINED WITH THE INERTIAL FORCES BEFORE THEY ARE ENTERED INTO THE STRENGTH ANALYSIS PROGRAM.

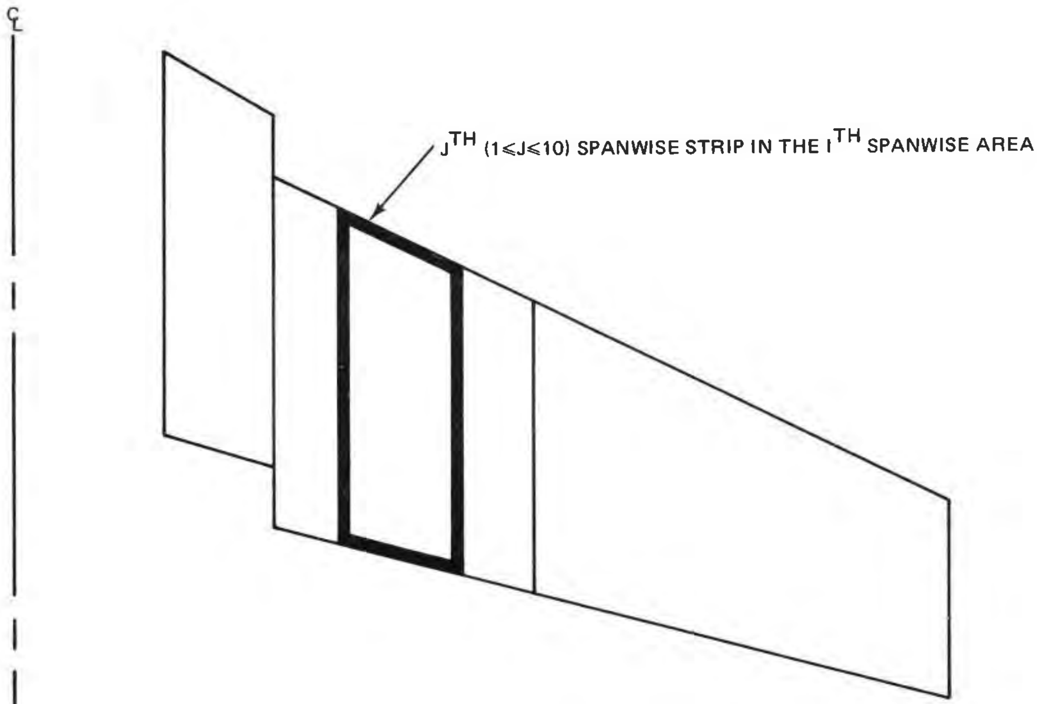


a. Basic Surface

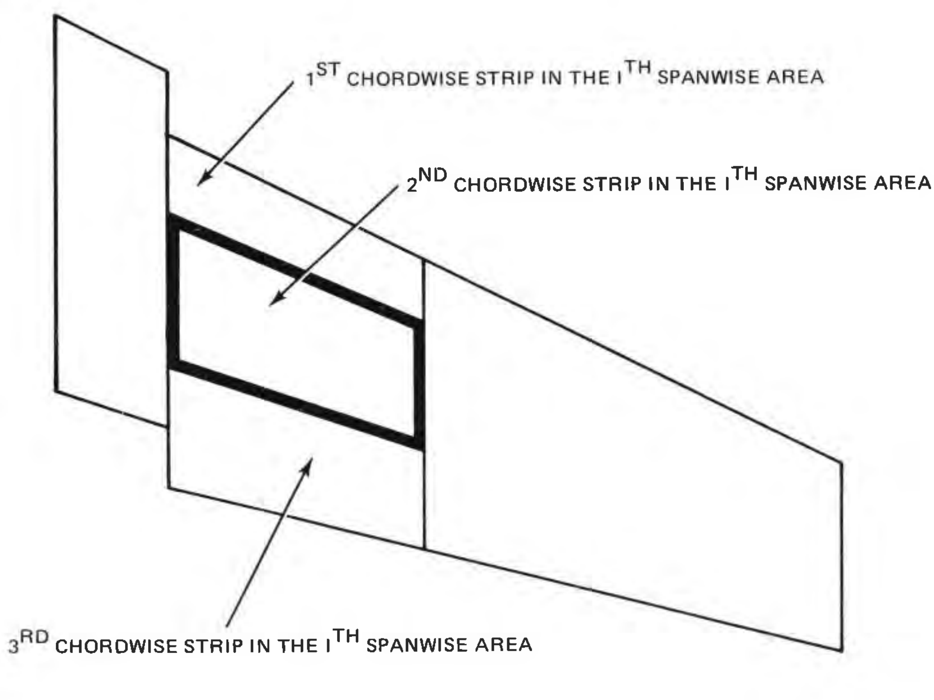


b. Spanwise Area (Maximum of N_{sa} Areas)

Figure 1 Definition of Surface Properties (Sheet 1 of 3)

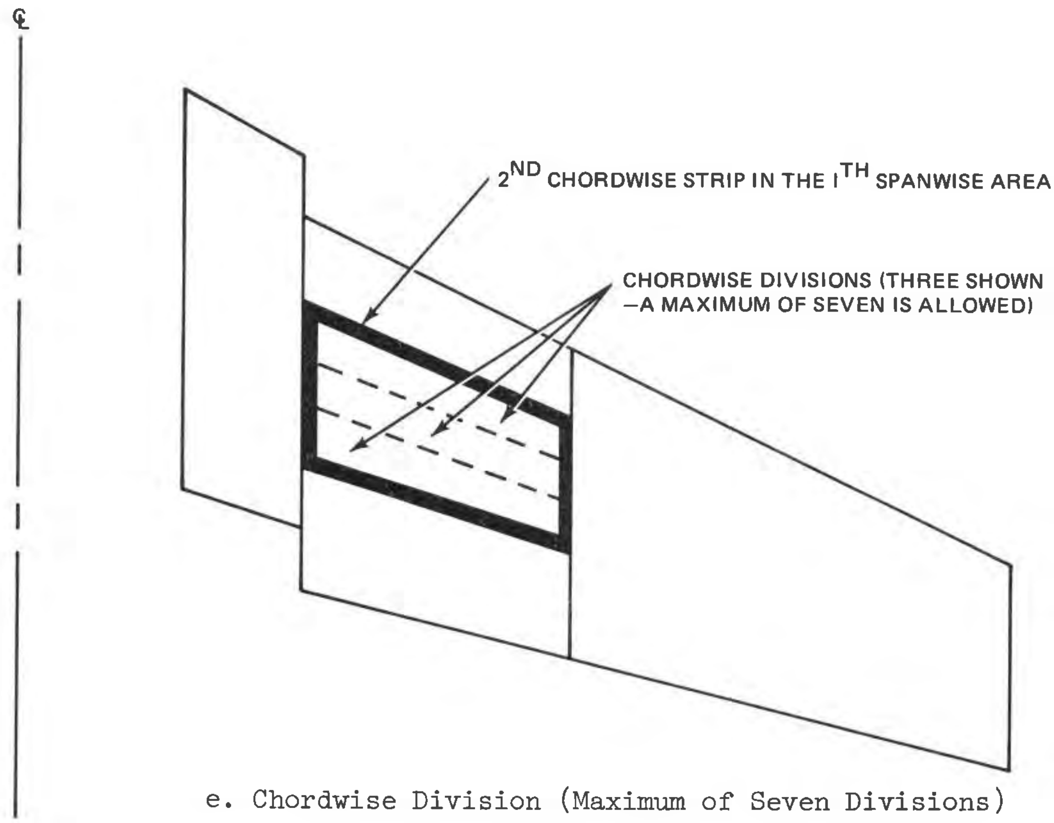


c. Spanwise Strip (Maximum of Ten Strips)



d. Chordwise Strip (Maximum of Three Strips)

Figure 1 Definition of Surface Properties (Sheet 2 of 3)



e. Chordwise Division (Maximum of Seven Divisions)

Figure 1 Definition of Surface Properties (Sheet 3 of 3)

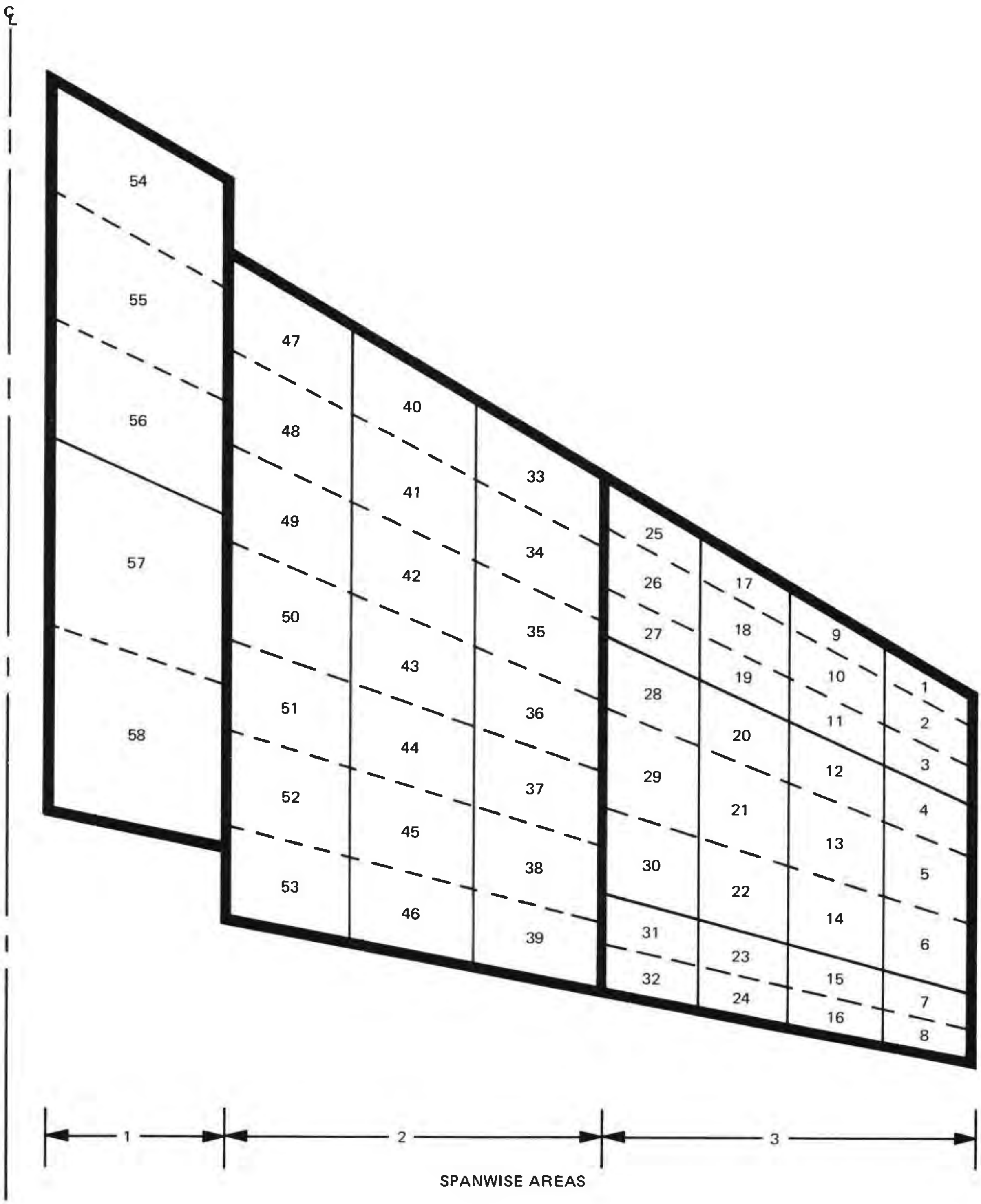


Figure 2 Typical Definition of Panels

ASAM/ASOM - AUTOMATED STRENGTH ANALYSIS/OPTIMIZATION MODULE

I. PROGRAM APPLICATION

A. GENERAL DESCRIPTION AND LIMITATIONS

THE OPTIMIZATION PROGRAM WRITTEN IN FORTRAN IV LANGUAGE, HAS THE FOLLOWING RESTRICTIONS.

(1) MAXIMUM NUMBER OF NODES = 1000.
(2) MAXIMUM NUMBER OF DEGREES OF FREEDOM = 6000.
(3) MAXIMUM NUMBER OF MEMBERS = 3000.
(4) MAXIMUM NUMBER OF LOAD CASES = 8.

BEFORE DESCRIBING IN DETAIL THE INPUT AND OUTPUT FORMATS, SEVERAL COMMENTS SHOULD BE MADE REGARDING THE PROGRAM'S LIMITATIONS AND HOW THE USER MAY MINIMIZE THEIR EFFECTS. THE BANDWIDTH OF THE STRUCTURE'S STIFFNESS MATRIX IS DETERMINED BY HOW FAR APART TWO STRUCTURALLY CONNECTED DEGREES OF FREEDOM ARE IN NUMBER. IF THE MOST EFFICIENT NODE NUMBERING SCHEME IS USED AND THE BANDWIDTH IS MINIMIZED, A LARGE SAVING IN COMPUTER TIME CAN BE ATTAINED. FURTHERMORE, THE MEMBER DATA SHOULD BE ARRANGED SEQUENTIALLY SO THAT IT RUNS APPROXIMATELY PARALLEL TO THE NODE NUMBERING IN THE GEOMETRY DATA. IF THIS IS DONE, TWO ADJACENT MEMBERS IN THE STRUCTURE WILL BE REASONABLY CLOSE TO EACH OTHER IN THE DECK OF MEMBER DATA. THIS IS REQUIRED BECAUSE THE TOTAL FORCES ARE SUMMED IN BLOCKS AND STORED, BLOCK BY BLOCK. THE SEQUENCING OF THE MEMBER DATA WILL INSURE THAT THESE BLOCKS ARE GENERATED IN THE MOST EFFICIENT MANNER.

INFORMATION ON HOW TO PREPARE INPUT DATA AND INTERPRET OUTPUT RESULTS IS CONTAINED IN THE FOLLOWING SECTIONS.

PRIOR TO THE READING OF ANY LARGE BLOCKS OF DATA DESCRIBING THE STRUCTURE AND ITS LOADING, CERTAIN GENERAL TYPE DATA ARE ENTERED INCLUDING CLUES TO CONTROL THE SEQUENCING OF OPERATIONS AND THE OUTPUT REQUIRED. SOME OF THESE CLUES ARE PRIMARILY FOR THE CONVENIENCE OF THE PROGRAMMER WHO IS FAMILIAR WITH THE INTERNAL WORKINGS OF THE SYSTEM. THEY YIELD ARRAYS, NAME LISTS, AND MATRIX RESIDENCE INFORMATION FOR DEBUGGING PURPOSES. THESE CLUES ARE USEFUL TO THE USER WHO IS FAMILIAR WITH THE ROUTINES WHICH YIELD THIS OUTPUT.

FOLLOWING THE GENERAL TYPE DATA, DATA BLOCKS DESCRIBING THE ANALYSIS PROBLEM TO BE SOLVED ARE READ. CARD INPUT TO THE LARGE SCALE PROGRAM CONSISTS OF NINE DATA BLOCKS. OF COURSE, ALL NINE MAY NOT BE NECESSARY FOR A PARTICULAR PROBLEM, BUT PROVISION IS MADE FOR THE FOLLOWING BLOCKS.

(1) GEOMETRY COORDINATES AND BOUNDARY CONDITIONS.
(2) GEOMETRY COORDINATES ONLY.
(3) BOUNDARY CONDITIONS ONLY.
(4) MATERIAL PROPERTIES UPDATE.
(5) MEMBER PROPERTIES.
(6) LOAD CONDITIONS.
(7) CONDENSED BOUNDARY CONDITIONS.
(8) FOR FUTURE USE.
(9) STABILITY CONDITIONS.

ALL OF THE ABOVE DATA SETS BEGIN WITH A LABEL CARD AND END WITH A BLANK CARD. THE LABEL CARD HAS THE FOLLOWING FORM THAT BEGINS IN COLUMN 6.

LABEL(ITYPED), NAMEA, NAMEB

WHERE ITYPED = 1,...,9 DENOTES THE DATA BLOCK NUMBER AS SHOWN ABOVE AND NAMEA AND/OR NAMEB MAY BE ANY ALPHAMERIC NAME OF UP TO EIGHT CHARACTERS. THE FORMAT FOR THE CARD INPUT CORRESPONDING TO THE NINE SETS ARE NOW PRESENTED.

B. NODAL GEOMETRY COORDINATES AND BOUNDARY CONDITIONS

THE NODAL GEOMETRY AND BOUNDARY CONDITION DATA ARE ENTERED AS SHOWN ON FIGURE 1. THE NODE NUMBER (I4 FORMAT) IS ENTERED IN COLUMNS 1-4 FOLLOWED BY THREE E13 FIELDS FOR X, Y, AND Z GLOBAL COORDINATES. THE BOUNDARY CONDITIONS ARE ENTERED IN COLUMNS 54 THRU 59 USING THE FOLLOWING CLUES.

0 (OR BLANK) - ZERO DISPLACEMENT COMPONENT. THIS CLUE CAUSES THE ROW AND COLUMN FOR THE PARTICULAR DISPLACEMENT COMPONENT TO BE REMOVED FROM THE STRUCTURAL MATRICES THAT ARE CREATED.

1 A ONE IN ANY OR ALL SIX BOUNDARY CONDITION COLUMNS INDICATE A 'FREE' (NOT SPECIFIED) DEGREE OF FREEDOM.

THE REMAINING COLUMNS ON THE CARD ARE NOT USED.

THE GEOMETRY AND BOUNDARY CONDITION DATA SHOULD BE ENTERED WITH THE NODES IN ASCENDING NUMERICAL ORDER. NODES WITH COORDINATES OF ZERO AND BOUNDARY CONDITIONS OF ZERO, REFERRED TO AS SLACK NODES, MAY BE INTERSPERSED IN THE DATA WITH THE PROGRAM EFFECTIVELY IGNORING THEM. SHOULD THE USER WISH TO MODIFY THE ORIGINAL IDEALIZATION OF A LARGE PROBLEM, THESE ADDITIONAL POSITIONS IN THE DATA WILL BE AVAILABLE. GEOMETRY AND BOUNDARY CONDITIONS ARE ENTERED INTO THE SYSTEM IN ANY ONE OF FOUR WAYS.

1. GEOMETRY COORDINATES AND BOUNDARY CONDITIONS

THE DATA IN THE FORMAT INDICATED BY FIGURE 1 ARE PRECEDED BY A

LABEL(1), NAMEA, NAMEB CARD, WHERE,

NAMEA = NAME FOR THE GEOMETRY PSEUDO MATRIX.
NAMEB = NAME FOR THE BOUNDARY CONDITION PSEUDO MATRIX.

2. GEOMETRY COORDINATES ONLY

THE DATA IN THE FORMAT INDICATED BY FIGURE 1 ARE PRECEDED BY A LABEL(2), NAMEA CARD, WHERE,

NAMEA = NAME FOR THE GEOMETRY PSEUDO MATRIX.
ANY DATA IN THE BOUNDARY CONDITION FIELDS WILL BE IGNORED.

3. BOUNDARY CONDITIONS ONLY

THE DATA IN THE FORMAT INDICATED BY FIGURE 1 ARE PRECEDED BY A LABEL(3), NAMEB CARD, WHERE,

NAMEB = NAME FOR THE BOUNDARY CONDITION PSEUDO MATRIX.
ANY DATA IN THE GEOMETRY FIELDS WILL BE IGNORED.

4. CONDENSED BOUNDARY CONDITIONS

THE DATA IN THE FORMAT INDICATED BY FIGURE 2, ARE PRECEDED BY A LABEL(7), NAMEB CARD, WHERE,

NAMEB = NAME FOR THE BOUNDARY CONDITION PSEUDO MATRIX.

THE BOUNDARY CONDITIONS ARE SPECIFIED USING A SPECIAL CONDENSED FORMAT WHERE THE 'TYPICAL' NODAL DEGREES OF FREEDOM ARE INDICATED AND ALL EXCEPTIONS ARE SPECIFIED. THE FORMAT IS VERY USEFUL WHERE THE BOUNDARY CONDITIONS FORM A PATTERN WHICH IS VERY REPETITIVE. THE FIRST CARD IN THE DATA INDICATES THE STANDARD DEGREES OF FREEDOM (COLUMNS ONE THROUGH SIX, CONTAIN ZERO OR ONE, CORRESPONDING TO THE SIX DEGREES OF FREEDOM DELTAX, DELTAY, DELTAZ, THETAX, THETAY, AND THETAZ). COLUMNS SEVEN THROUGH TEN CONTAIN THE TOTAL NUMBER OF NODES IN THE STRUCTURE. THE REMAINING DATA CARDS INDICATE DEGREES OF FREEDOM THAT ARE EXCEPTIONS TO THE STANDARD. TWELVE FIELDS OF I5 FORMAT MAY BE USED TO RECORD THIS INFORMATION WHERE A MINUS SIGN INDICATES THROUGH. FOR EXAMPLE, IN FIGURE 2, A STRUCTURE CONTAINS 324 NODES WHERE THE STANDARD DEGREES OF FREEDOM AT EACH NODE ARE 1, 1, 1, 0, 0, 0. THE EXCEPTIONS TO THIS ARE INDICATED IN THE CARDS THAT FOLLOW. THUS NODES 5, 8, 30-36, 80 ETC. HAVE DEGREES OF FREEDOM 1, 1, 0, 0, 0, 0. NOTE THAT THESE NODES DO NOT HAVE TO BE IN SEQUENCE. HOWEVER, A BLANK WITHIN THE 12I5 DATA FIELDS IS NOT PERMITTED. ALL OF THE FIRST N FIELDS OF A MAXIMUM OF TWELVE MUST BE FILLED IN. A BLANK WILL CAUSE THE REMAINING FIELDS TO BE IGNORED.

C. MATERIAL PROPERTIES UPDATE

THE DATA IN THE FORMAT INDICATED BY FIGURE 5 ARE PRECEDED BY A LABEL(4) CARD.

THE SYSTEM HAS A LIMITED NUMBER OF STANDARD MATERIALS THAT ARE INCORPORATED INTO THE PROGRAM UNDER SPECIFIC MATERIAL CODES (FIGURE 4). IF THE USER DOES NOT FIND APPROPRIATE MATERIAL IN THE TABLE OF STANDARDS, OR IF HE WISHES TO ENTER STANDARD MINIMUM AND MAXIMUM SIZES, HE MAY SET UP HIS OWN MATERIAL CODES AND ASSOCIATED MATERIAL TABLES. THIS IS DONE BY PREPARING DATA AS SHOWN IN FIGURE 5. WHEN THE MATERIAL TABLES ARE INPUT WITH THE ANALYSIS, THEY MUST BE BEFORE THE MEMBER DATA (LABEL(5), NAMEA). THE FOLLOWING ITEMS APPLY WHEN THE LABEL(4) DATA IS SUBMITTED WITH THE ANALYSIS.

(1) THE LABEL(4) DATA UPDATE THE MATERIAL PROPERTIES TABLE IN THE MEMBIN SUBROUTINE. THIS IS THE SUBROUTINE WHICH CREATES THE MEMBER PSEUDO MATRIX.
(2) THE MATERIAL TABLE WITHIN MEMBIN IS UPDATED FOR THIS JOB ONLY.
(3) A VALUE FOR EACH OF THE PHYSICAL PROPERTIES (ELASTIC MODULUS, POISSON'S RATIO, DENSITY, AND ALLOWABLE STRESSES) MUST BE PRESENT WHEN ENTERING A MATERIAL TABLE. FAILURE TO INCLUDE ALL THE VALUES WILL RESULT IN FAILURE OF THE RUN.
(4) MAXIMUM AND MINIMUM SIZES ARE ENTERED BY INCREMENTING THE MATERIAL CODE BY 100 AND INCLUDING ONE MATERIAL CARD PER MATERIAL AS SHOWN IN FIGURE 5.

D. LOAD CONDITIONS

FOR PURPOSES OF ENTERING APPLIED EXTERNAL LOADS, IT IS MOST DESIRABLE TO WORK WITH PHYSICAL DESIGNATIONS SUCH AS NODE NUMBER AND COMPONENT RATHER THAN THE ROW NUMBER OF A MATRIX. THIS IS ESPECIALLY TRUE WHERE THE STRUCTURE HAS MIXED NODAL DEGREES OF FREEDOM AND IT BECOMES CUMBERSOME TO KEEP A COUNT ON THE LINE-UP OF THE DEGREES OF FREEDOM. THE LABEL(6) CARD PROVIDES FOR ENTERING THE LOAD MATRIX WHERE THE PHYSICAL DESIGNATIONS ARE USED RATHER THAN THE ROW NUMBER. THE ACTUAL DATA ARE ENTERED AS SHOWN IN FIGURE 6. THE FOLLOWING RULES APPLY IN FILLING OUT THIS DATA FORM.

(1) THE LABEL(6) CARD INCLUDES THE NAME OF THE PSEUDO MATRIX WHICH IS FOLLOWED BY THE NUMBER OF CONDITIONS (COLUMNS) ENCLOSED IN PARENTHESES. USING THIS TYPE OF DATA INPUT (PSEUDO MATRIX) THE PROGRAM GENERATES THE ACTUAL LOAD MATRIX.
(2) ONE, TWO, OR THREE FIELDS MAY BE USED, STARTING AT THE LEFT SIDE OF THE FORM AND WORKING TOWARD THE RIGHT SIDE.
(3) THE ENTIRE BLOCK OF DATA MUST BE FILLED OUT IN ASCENDING ORDER OF THE NODE NUMBERS.

(4) WITHIN A GIVEN NODE, THE COMPONENTS MUST BE IN ASCENDING ORDER (FX, FY, FZ, MX, MY, OR MZ).
(5) WITHIN A GIVEN NODE AND COMPONENT, THE CONDITION NUMBER (COLUMN NUMBER) MUST BE IN ASCENDING ORDER.
(6) ONLY NON-ZERO VALUES ARE ENTERED, ALTHOUGH A ZERO VALUE IS A LEGITIMATE NUMBER.

FIGURE 6 ILLUSTRATES HOW THE DATA SHOULD BE PREPARED FOR THE LOAD MATRIX SHOWN IN FIGURE 7. NOTE THE 8 WITHIN THE PARENTHESES THAT IMMEDIATELY FOLLOWS THE MATRIX NAME ON THE LABEL(6) CARD. THIS INDICATES THAT THE MATRIX CONTAINS 8 CONDITIONS (COLUMNS). NOTE ALSO THAT ONE, TWO, OR THREE ELEMENTS MAY BE PLACED ON A SINGLE CARD AND THAT THE CARDS ARE IN ASCENDING SEQUENCE OF NODE NUMBER, COMPONENT, AND CONDITION NUMBER. THE EXAMPLE ILLUSTRATES THE DIFFERENT TYPES OF SYMBOLS THAT MAY BE USED TO DESIGNATE THE COMPONENT TYPE.

E. MEMBER PROPERTIES

THE DATA IN THE FORMAT INDICATED BY FIGURE 3 ARE PRECEDED BY A LABEL(5), NAMEC CARD, WHERE,

NAMEC = ANY EIGHT CHARACTER ALPHAMERIC NAME THAT THE USER ASSIGNS TO THE DATA.

THE MEMBER DATA, WHICH SHOULD APPEAR AS THE LAST DATA BLOCK, HAS BEEN DESIGNED SO THAT IT MAY EASILY BE EXPANDED TO HANDLE A WIDE VARIETY OF IDEALIZATIONS AND TYPES OF PROBLEMS. FOR EXAMPLE, THE TYPES OF STRUCTURE CAN VARY FROM TRUSSES WHICH CONTAIN BAR ELEMENTS THAT CONNECT TWO NODES AND HAVE ONE ELASTIC CONSTANT TO ANISOTROPIC SOLIDS THAT HAVE MEMBERS WHICH CONNECT EIGHT NODES AND CONTAIN TWENTY-ONE ELASTIC CONSTANTS. GEOMETRIC PROPERTIES CAN VARY FROM ONE FOR A BAR TO FIVE FOR A BEAM. WITH ALL OF THESE VARIOUS COMBINATIONS, IT WAS NECESSARY TO DEVELOP A RATHER GENERAL TYPE OF INPUT FORMAT FOR THE MEMBER DATA. WITH THIS GENERAL FORMAT THE PROGRAM WILL BE ABLE TO ACCOMMODATE NEWER AND MORE REFINED ELEMENTS. THE DATA FORMAT IS SHOWN IN FIGURE 3.

THE MEMBER DATA HAVE BEEN SUBDIVIDED INTO THREE BASIC CATEGORIES (DATA CLASS), WHICH IN TURN ARE FURTHER SUBDIVIDED INTO SUBCATEGORIES (SUB CLASS). THE MAJOR CATEGORIES ARE

(1) TOPOLOGY AND GEOMETRIC PROPERTIES.
(2) ELASTIC PROPERTIES.
(3) DATA FOR FUTURE USE.
(4) DATA FOR FUTURE USE.
(5) ALLOWABLE STRESSES AND PRESCRIBED SIZES.

AS INDICATED IN FIGURE 3, DATA ARE INDICATED AS BELONGING TO A SPECIFIC DATA CLASS BY PUNCHING A DIGIT FROM 1 TO 5 IN COLUMN FIFTEEN. THE PARTICULAR SUBCLASS OF THE DATA IS INDICATED BY PUNCHING THE APPROPRIATE DIGIT IN COLUMN SIXTEEN. THE

APPROPRIATE DIGIT IN A SUBCLASS IS A SEQUENTIAL NUMERICAL NUMBER, BEGINNING WITH THE VALUE ONE, WHICH ASSOCIATES THE ORDER OF THE DATA CARDS WHICH BELONG TO A PARTICULAR DATA CLASS GROUP. THE DATA HAVE BEEN ARRANGED SUCH THAT THE AMOUNT OF INPUT INCREASES WITH PROBLEM COMPLEXITY. FOR STANDARD ELASTIC ANALYSES WHERE THE MEMBERS ARE ISOTROPIC, THE INPUT DATA ARE MINIMAL. IN THIS CASE ALL OF THE ELASTIC CONSTANTS ARE COMPUTED BY THE PROGRAM, THE ONLY INPUT BEING THE MATERIAL CODE. IF A PARTICULAR MEMBER IS ANISOTROPIC, THEN THE ELASTIC CONSTANTS MUST BE SPECIFIED.

THE THREE EXISTING CATEGORIES OF DATA ARE SUBDIVIDED ACCORDING TO THE FOLLOWING LIST. THE ITEM NUMBERS AND THEIR LOCATION ON THE INPUT FORM ARE SHOWN IN FIGURE 3. THE USER IS REFERRED TO THE FINITE ELEMENT CATALOGUE FOR DETAILED INSTRUCTIONS CONCERNING THE INPUT FOR THE VARIOUS FINITE ELEMENTS. IT SHOULD BE NOTED THAT THE MEMBER NUMBER MUST BE PUNCHED ON EVERY INPUT CARD (ITEM 1 IN THE FOLLOWING LIST).

1. TOPOLOGY AND GEOMETRIC PROPERTIES

A DATA CLASS VALUE OF ONE IS ASSIGNED TO THE TOPOLOGY AND GEOMETRIC PROPERTIES AS INDICATED IN FIGURE 3, AND 'FINITE ELEMENT CATALOGUE' SECTION. ITEM NUMBERS IN THE FIGURE ARE DEFINED BELOW.

ITEM 1.
MEMBER NUMBER.

ITEM 2.
MEMBER TYPE.

ITEM 3.
MATERIAL CODE. A CODE WHICH INDICATES THE TYPE OF MATERIAL AND ITS PROPERTIES. THE PROGRAM HAS BUILT-IN STANDARDS. HOWEVER, THE USER MAY SPECIFY HIS OWN MATERIAL PROPERTIES BY ENTERING A MATERIAL TABLE.

ITEM 5.
CONSTRUCTION CODE. THIS FACTOR IS USED TO SELECT STABILITY TABLES FOR THE MEMBER. (SEE SECTION ON LABEL(9) DATA SET).

ITEMS 6 TO 25.
A MAXIMUM OF TWENTY NODES PER ELEMENT. THIS IS THE TOPOLOGICAL DATA WHICH INDICATES THE NODES THAT A PARTICULAR MEMBER CONNECTS.

ITEMS 26 TO 35.
GEOMETRIC PROPERTIES OF THE MEMBER (THICKNESS, AREA, MOMENTS OF INERTIA, ETC.).

2. ELASTIC PROPERTIES

A DATA CLASS VALUE OF TWO IS ASSIGNED TO THE ELASTIC PROPERTIES AS INDICATED IN FIGURE 3, AND 'FINITE ELEMENT CATALOGUE' SECTION. ITEM NUMBERS IN THE FIGURE ARE DEFINED BELOW.

ITEMS 36 TO 60.
THESE FACTORS ARE USED TO INDICATE THE ELASTIC CONSTANTS. FOR STANDARD ISOTROPIC ELASTIC ANALYSES, THESE FACTORS NEED NOT BE SPECIFIED AS THE PROGRAM WILL COMPUTE THEM BASED ON THE MATERIAL CODE. FOR ANISOTROPIC MEMBERS, THESE FACTORS MUST CONTAIN THE SPECIFIC VALUES AS INDICATED IN THE MEMBER 'FINITE ELEMENT CATALOGUE' SECTION.

3. AND 4. DATA FOR FUTURE USE

THE DATA CLASS VALUES OF THREE AND FOUR ARE ASSIGNED TO THE DATA FOR FUTURE USE AS INDICATED IN FIGURE 3. ITEM NUMBERS IN THE FIGURE ARE DEFINED BELOW.

ITEMS 61 TO 80.
THESE ITEMS ARE RESERVED FOR POSSIBLE EXPANSION OF THE PROGRAM'S CAPABILITIES.

FOR A PARTICULAR STRUCTURE CONTAINING N MEMBERS, THE MEMBER DATA ARE STORED AS A PSEUDO MATRIX OF N ROWS BY 100 COLUMNS. THE FIRST NINETY COLUMNS ARE THE SAME QUANTITIES AS ILLUSTRATED IN FIGURE 3. THE LAST TEN ARE USED FOR INTERNAL CLUE DATA.

5. ALLOWABLE STRESSES AND PRESCRIBED SIZES.

A DATA CLASS VALUE OF FIVE IS ASSIGNED TO THE ALLOWABLE STRESS AND PRESCRIBED SIZES AS INDICATED IN FIGURE 3. ITEM NUMBERS IN THE FIGURE ARE DEFINED BELOW.

ITEMS 81 TO 85.
THE FIRST THREE ITEMS CONTAIN THE TENSION, COMPRESSION, AND SHEAR ALLOWABLE STRESSES FOR THE MEMBER. AS CAN BE SEEN FROM FIGURE 3, THEY ARE ENTERED ON THE CARD WITH THE DATA CLASS 51. IF A 51 CARD IS NOT INPUT, THE PROGRAM WILL USE A SET OF BUILT-IN ALLOWABLES FOR ALUMINUM, TITANIUM, AND STEEL. THESE CAN BE FOUND IN FIGURE 4 IN CONJUNCTION WITH THE DISCUSSION ON THE MATERIALS TABLE. THE LAST TWO ITEMS ON THE 51 CARD ARE RESERVED FOR MINIMUM (ITEM 84) AND MAXIMUM (ITEM 85) SIZES. IF THE USER DOES NOT PRESCRIBE SIZE LIMITATIONS, THE PROGRAM WILL SET A MINIMUM SIZE OF 0.0001 IN ORDER TO PREVENT A MEMBER FROM BECOMING SO SMALL THAT THE STRUCTURE'S STIFFNESS MATRIX BECOMES SINGULAR. IF VALUES ARE GIVEN HERE, THEY WILL OVERIDE THOSE THAT MAY BE SUPPLIED WITH THE MATERIAL UPDATE TABLE.

F. DEFLECTION CONSTRAINT CONDITIONS

DEFLECTION CONSTRAINT DATA DO NOT APPLY.

G. STABILITY CONDITIONS

FOR SOME STRUCTURAL PROBLEMS, DESIGN ALLOWABLE STRESSES MAY HAVE TO BE ALTERED TO PREVENT LOCAL INSTABILITY OF VARIOUS MEMBERS. THE VARIATIONS IN THESE ALLOWABLES ARE USUALLY FUNCTIONS OF THE LOAD LEVELS TO WHICH THE MEMBER HAS BEEN SUBJECTED. FOR EXAMPLE IN THE DESIGN OF THE WING'S COVER, THE COMPRESSIVE STRESS ALLOWABLE MAY BE A FUNCTION OF TWO VARIABLES, THE COMPRESSIVE AND SHEAR STRESS RESULTANTS. IN PRACTICE THE COMPRESSIVE STRESS RESULTANT IS NORMALLY DIVIDED BY THE UNSUPPORTED LENGTH OR RIB SPACING. SINCE THE PROGRAM WORKS WITH THE COMPRESSIVE STRESS RESULTANT ALONE ON THE ABSCISSA, A DIFFERENT TABLE FOR EACH RIB SPACING WOULD BE REQUIRED. IN THE CASE OF A BAR, THE ALLOWABLE STRESS MUST BE ENTERED AS A FUNCTION OF ONE VARIABLE, THE LENGTH OF THE BAR DIVIDED BY THE SQUARE ROOT OF THE CROSS-SECTIONAL AREA.

FOR SHEAR PANELS THE ALLOWABLE SHEAR STRESS IS ALSO ENTERED AS AN INSTABILITY TABLE WITH ONE VARIABLE. HERE THE VARIABLE IS THE THICKNESS OF THE SHEAR PANEL. INSTABILITY TABLES MAY BE SUPPLIED FOR THE SIZING OF ELEMENT TYPES 1, 5, 6, AND 8 ONLY. AN EXAMPLE WITH TWO INDEPENDENT VARABLES WILL NOW BE PRESENTED, BUT IT SHOULD BE KEPT IN MIND THAT A TABLE CONTAINING ONE CURVE WILL REPRESENT THE ONE-VARIABLE PROBLEM.

THE STABILITY TABLE DATA SET BEGINS WITH THE LABEL(9), NAMEA CARD. THE STABILITY TABLES (MAXIMUM OF TEN) FOLLOW THIS CARD AND THE DATA SET IS TERMINATED BY A BLANK CARD. AN EXAMPLE OF A STABILITY TABLE IS SHOWN IN FIGURE 8. EACH STABILITY TABLE CONTAINS A HEADER CARD SPECIFYING THE TABLE NUMBER, THE NUMBER OF ABSCISSAS (FIRST INDEPENDENT VARIABLE) AND THE NUMBER OF CURVES IN THE TABLE (SECOND INDEPENDENT VARIABLE). THE PROGRAM IS LIMITED TO HANDLING NINE ABSCISSAS AND NINE CURVES PER TABLE. FOLLOWING THE HEADER CARD IS A CARD SPECIFYING THE VALUE OF THE ABSCISSAS FOR WHICH ALLOWABLE STRESSES ARE GIVEN. NEXT, THE VALUE OF THE SECOND INDEPENDENT VARIABLE AND CORRESPONDING ALLOWABLE STRESSES FOR THAT VARIABLE ARE ENTERED, ONE PER CARD (FIGURE 9). EACH SUCCEEDING CARD (CURVE) IS READ UNTIL THE TABLE IS COMPLETE AS DEFINED BY ITS HEADER CARD. THE PROGRAM THEN READS THE NEXT TABLE'S HEADER CARD, AND THE PROCESS CONTINUES UNITL A BLANK CARD IS ENCOUNTERED.

TO AVOID 'RUNNING OFF THE TABLE' AND THE NECESSITY FOR EXTRAPOLATION, IT IS SUGGESTED THAT THE FIRST ABSCISSA BE ZERO AND THE LAST BE VERY LARGE (SAY 1000000). THE SAME SHOULD BE TRUE FOR THE SECOND INDEPENDENT VARIABLE. IT SHOULD ALSO BE NOTED THAT EACH CARD FOR A STABILITY TABLE HAS A SEQUENCE NUMBER ENTERED IN I2 FORMAT IN COLUMNS 71 AND 72. THE SEQUENCE

NUMBERING BEGINS AT ZERO FOR THE HEADER CARD AND CONTINUES UNTIL THE TABLE IS COMPLETE.

H. FINITE ELEMENT CATALOGUE

FIGURES 10 TO 18 ILLUSTRATE AND DESCRIBE THE INPUT MEMBER DATA FOR THE FINITE ELEMENTS THAT ARE CURRENTLY CONTAINED IN THE PROGRAM. THE INPUT DATA ARE STORED ON FIELDS IN ACCORDANCE WITH FIGURE 3. IT SHOULD BE NOTED THAT IT IS NECESSARY TO PROVIDE CARDS FOR THE ELASTIC PROPERTIES OF EACH INDIVIDUAL MEMBER (DATA CLASS 2) IF THE MATERIAL IS ISOTROPIC. IN ANY CASE, A MATERIAL CODE MUST BE PROVIDED. THE MATERIAL CODE MAY BE EITHER A STANDARD CODE OR ANY SUITABLE CODE FROM 1 TO 20 PROVIDING A MATERIAL TABLE IS INCLUDED. SINCE THE 51 DATA CLASS CARD, CONTAINING TENSION, COMPRESSION, AND SHEAR ALLOWABLE STRESSES AND MINIMUM AND MAXIMUM SIZES, HAS THE SAME FORMAT FOR ALL THE ELEMENTS IT IS OMITTED FROM FIGURES 10 TO 18.

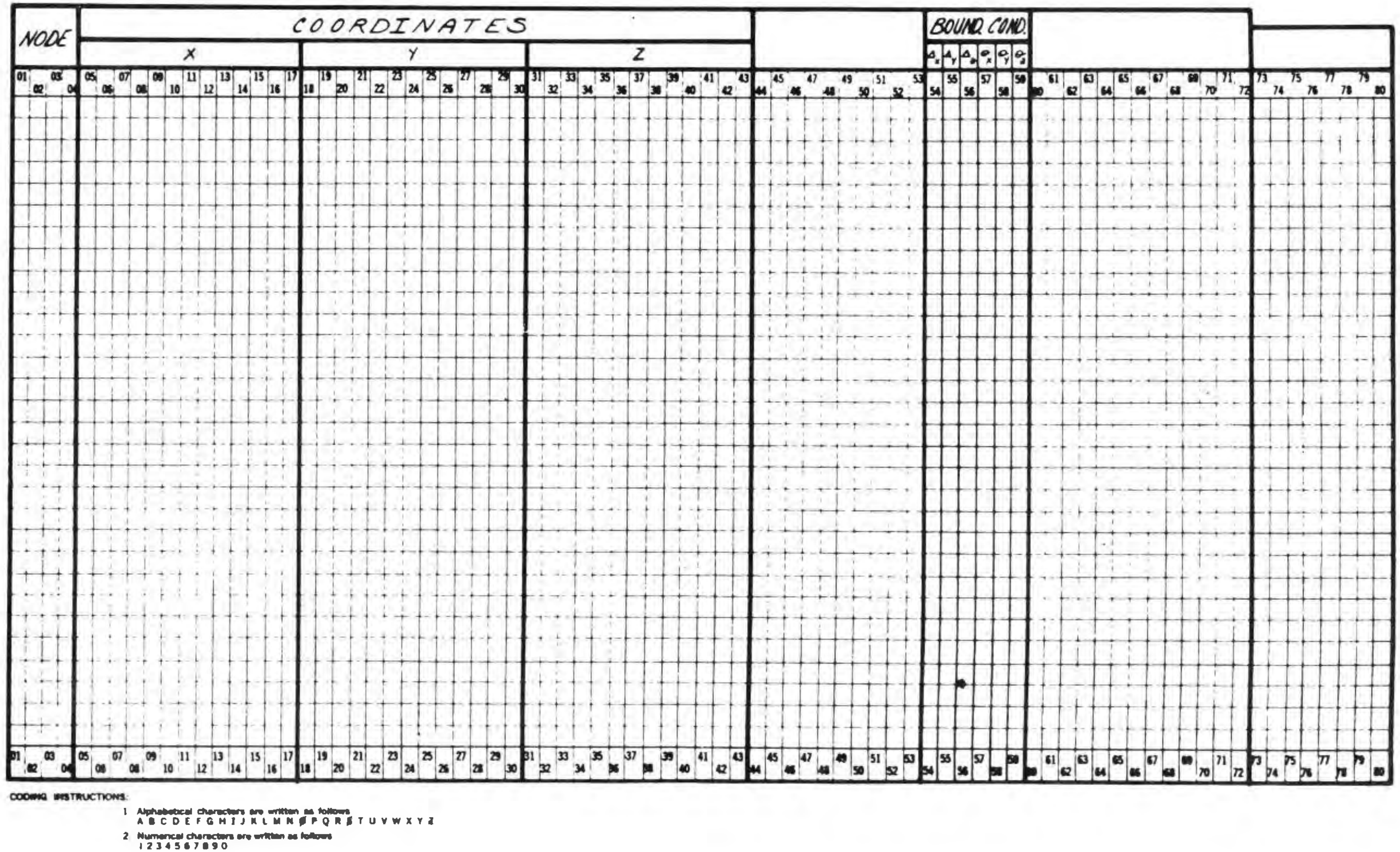


Figure 1 Geometry Coordinates and Boundary Conditions Format

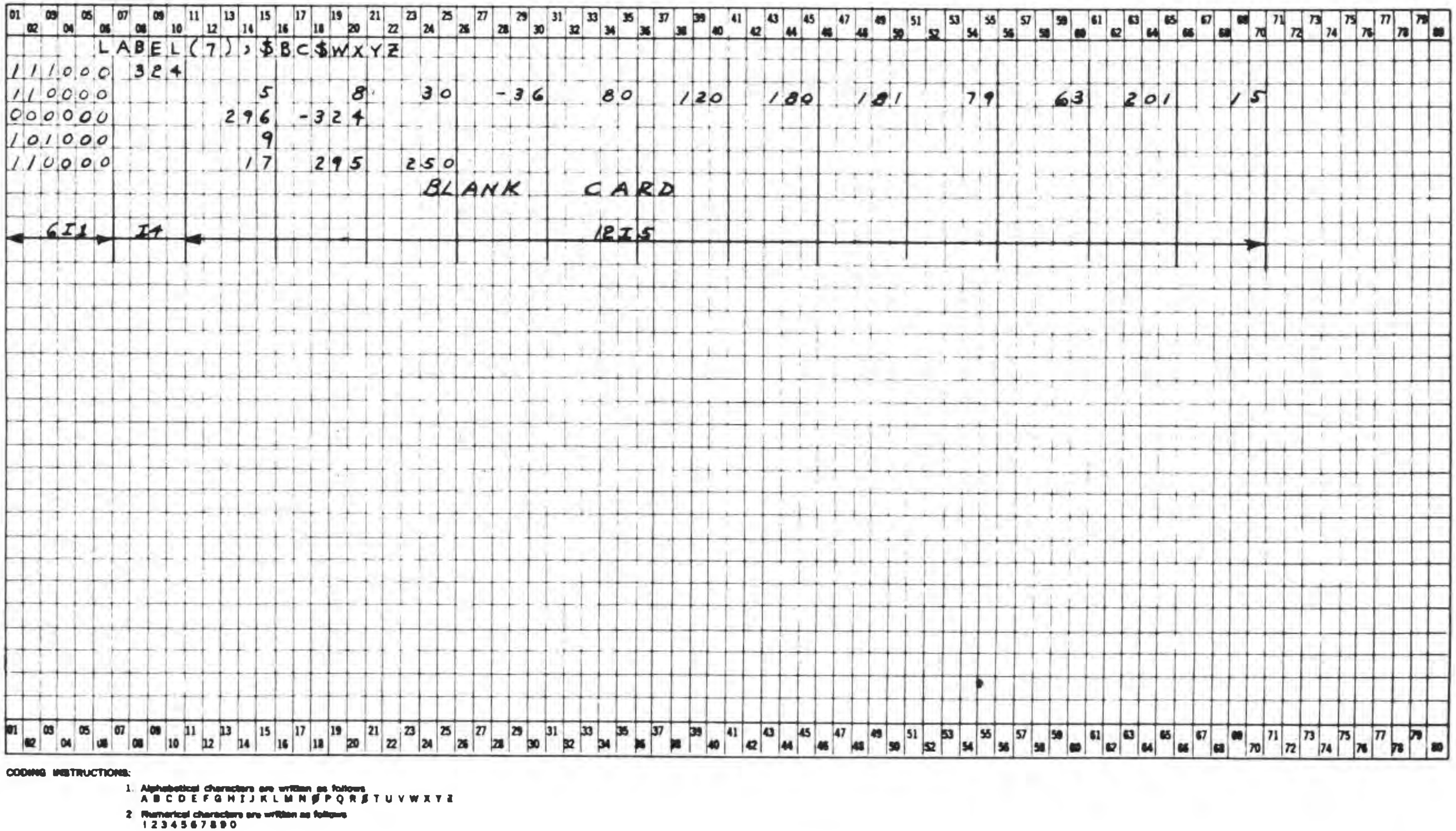


Figure 2 Condensed Boundary Condition Format

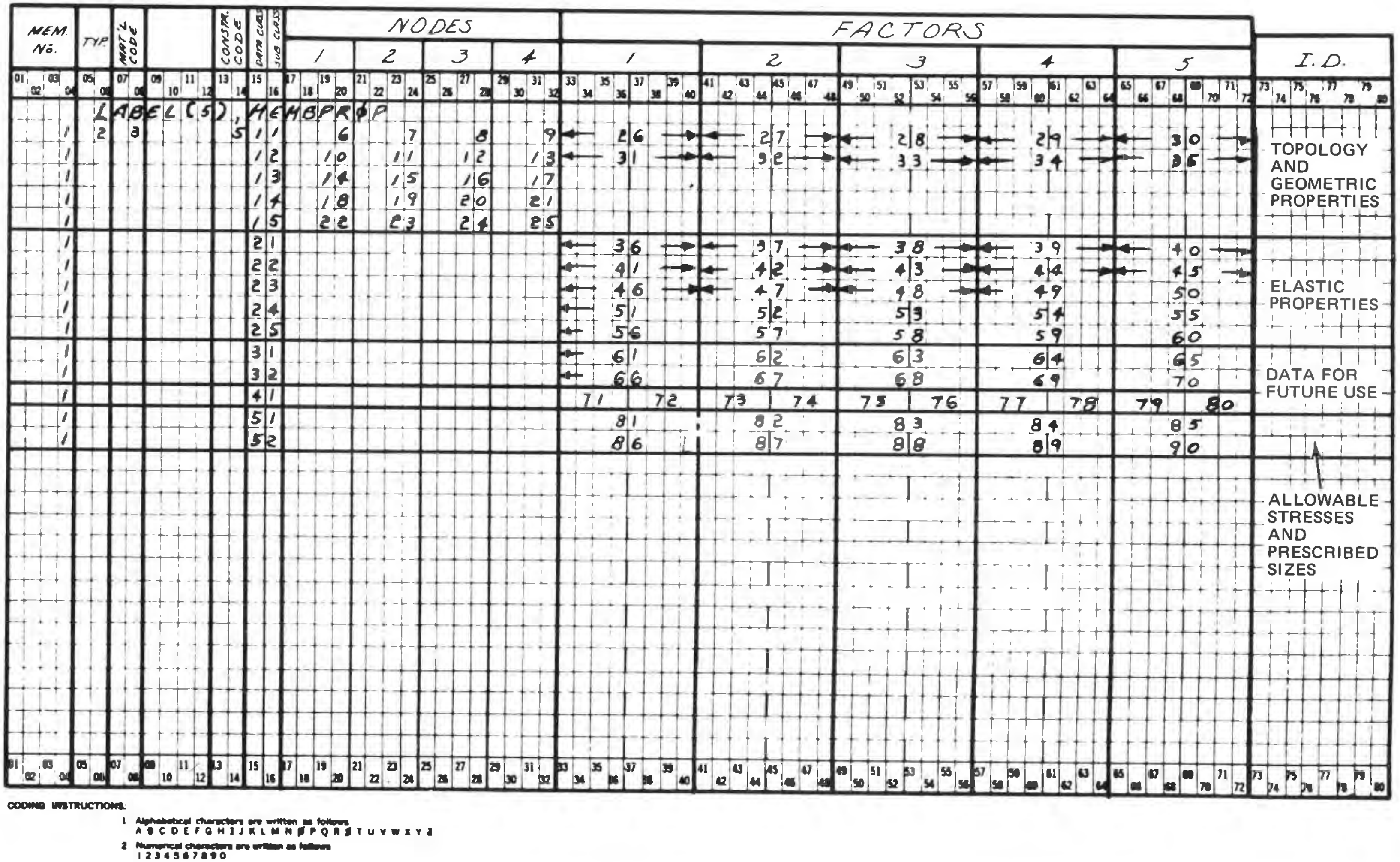


Figure 3 Member Properties Format

Mat'l Code	Material	Density lb/in.^{3}	Elastic Modulus	Poisson's Ratio	Allowable Stresses Tension	Comp.	Shear
1	Aluminum	0.100	1.05×10^7	0.3	67000	57000	39000
2	Steel	0.285	2.95×10^7	0.3	220000	213000	129000
3	Titanium	0.160	1.60×10^7	0.3	130000	127000	76000
4							
.							
.							
20							

Figure 4 Standard Materials

	Mat'l Code	Allowable Stresses Tension	Comp.	Shear	Elastic Modulus	Poisson's Ratio	Density	Mat'l Identity
5X	I3	6E8.0						

	Mat'l Code + 100	Minimum Size	Maximum Size		
5X	I3	2E8.0			

Figure 5 Format for Entering Materials Table

NODE	COMP.	COND.	VALUE	NODE	COMP.	COND.	VALUE	NODE	COMP.	COND.	VALUE	I. D.
		LABEL(6), $LTLWSIA(8)										$LTLWSIA
2	FX	1	7.43	2	FX	4	8.73	2	FX	5	9.62	
2	FX	6	-8.4	2	FY	1	2.6	2	FY	2	1.0	
2	FY	4	4.20	2	FY	6	3.1	2	FY	8	-8.63	
4	MZ	3	1.0	6	4	7	1.0	7	2	1	.93	
7	3	1	.76									
9	1	8	7.93									
9	2	8	21.8									
9	3	1	4.2	9	3	6	13.2					
15	1	1	6.1	15	1	4	21.72	15	3	4	-14.65	
20	4	1	-.84	20	5	4	-14.01	20	6	5	9.84	
21	X	1	132.63	21	Y	1	18.5					
21	Z	1	9.2									
												$LTLWSIA

CODING INSTRUCTIONS:

1 Alphabetical characters are written as follows
A B C D E F G H I J K L M N Ø P Q R S T U V W X Y Z

2 Numerical characters are written as follows
1 2 3 4 5 6 7 8 9 0

Figure 6 Load Conditions

Symbol	Load, lb or lb-in.							
	Load Condition No.							
	1	2	3	4	5	6	7	8
Fx2	7.43			8.73	9.62	-8.4		
Fy2	2.6	+1.0		4.20		3.1		-8.63
Mz4			+1.0					
Mx6							+1.0	
Fy7	.93							
Fx9	.76							
Fx9								7.93
Fy9								21.8
Fz9	4.2					13.2		
Fx15	6.1			21.72				
Fz15				-14.65				
Mx20	-.84							
My20				-14.01				
Mz20					9.84			
Fx21	132.63							
Fy21	18.5							
Fz21	9.2							

Note: Load Components are in Ascending Sequence

Figure 7 Example Load Input
FASTOP–SOP–ASAM

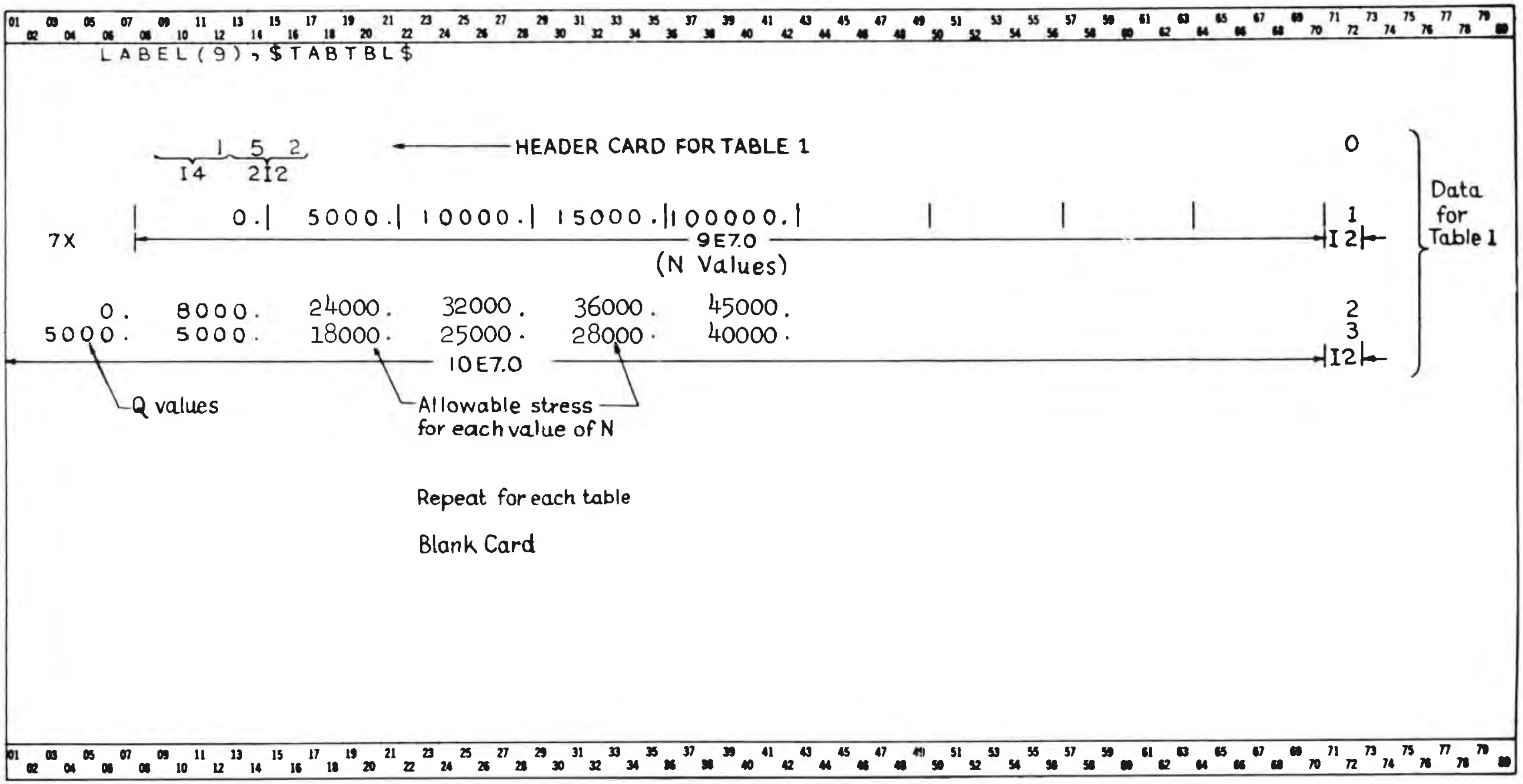
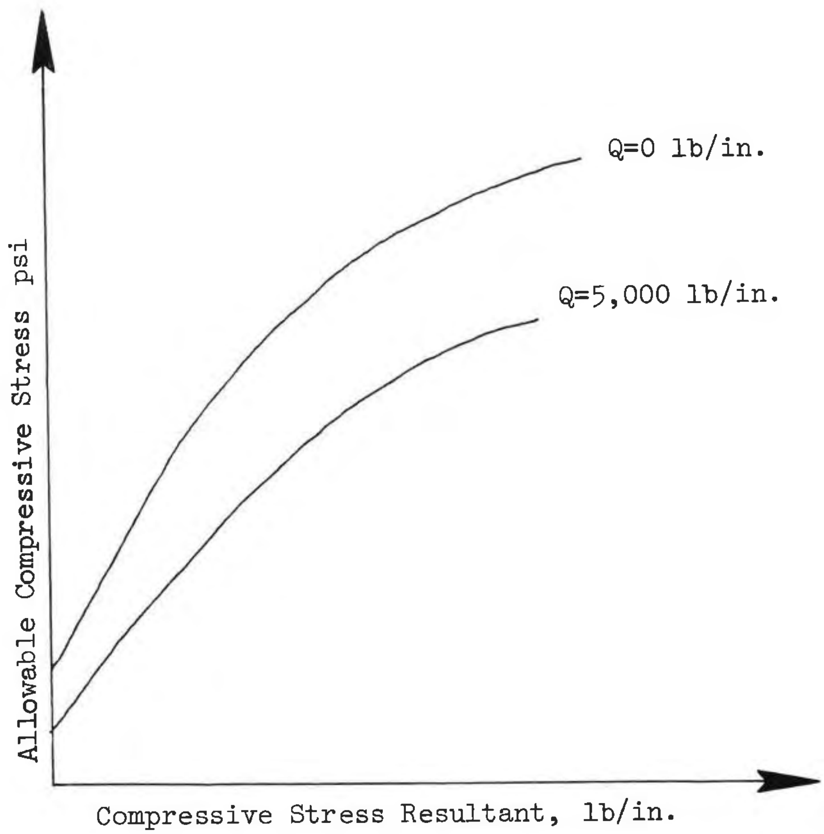


Figure 8 Example of Stability Table Input



Construction Code = 1, No. N's = 5, No. Q's = 2

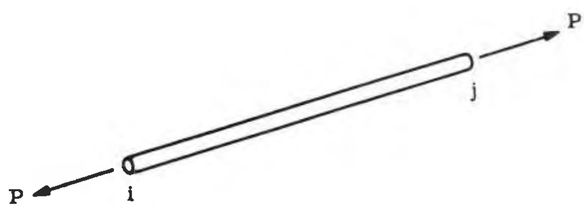
N values 0, 5, 10, 15, 100 K/in

Q values, K/in.	Stress Allowables, ksi
0	8, 24, 32, 36, 45
5	5, 18, 25, 28, 40

Repeated for each table

Figure 9 Example of the Relationships Implied by the Stability Table Data

ELEMENT No. 1



INPUT

	Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	No.	1				1	1	i	j			Area				
*	No.					2	1					E				

E = Modulus of Elasticity

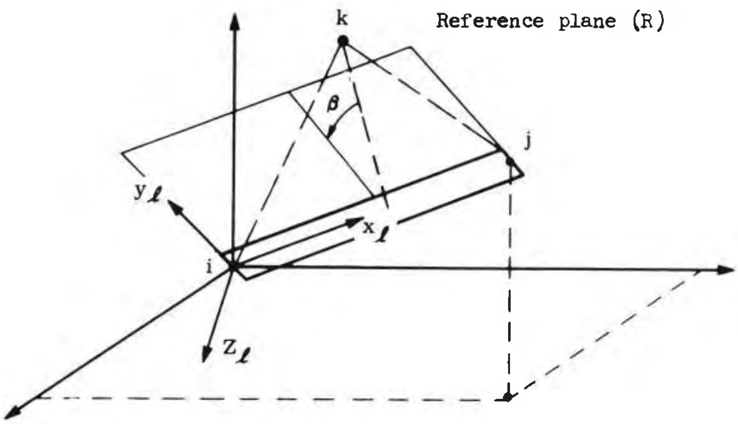
*This card needed only when overriding program-stored properties.

OUTPUT

P (Axial Load)

Figure 10 Bar Element

ELEMENT No. 2



Nodes i, j, k determine reference plane R. Angle β determines orientation of y_ℓ, z_ℓ axes with respect to reference plane R.

INPUT

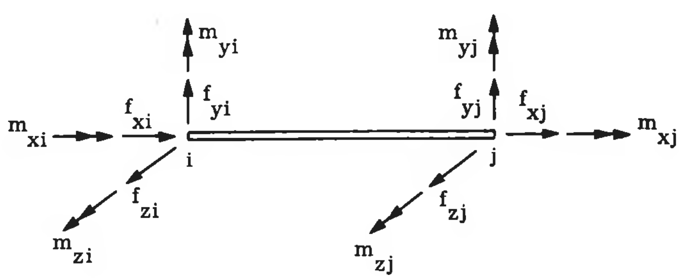
Member No.	Member Type	Matl. Code	Graphics	Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
No.	2				1	1	i	j	k		Area	β	I_{yy}	I_{zz}	J
* No.					2	1					E				

β is in degrees
J = Effective polar moment of inertia
E = Modulus of Elasticity

*This card needed only when overriding program-stored properties.

OUTPUT

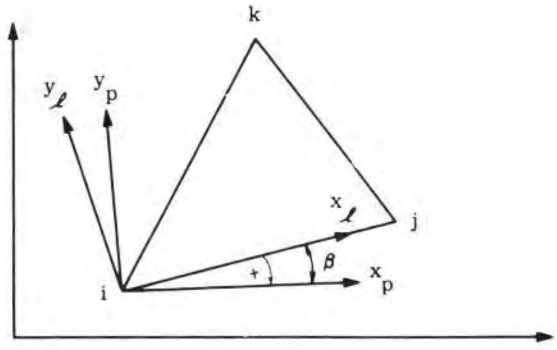
$$\left\{\begin{matrix} f_{xi} \\ f_{yi} \\ f_{zi} \\ m_{xi} \\ m_{yi} \\ m_{zi} \\ f_{xj} \\ f_{yj} \\ f_{zj} \\ m_{xj} \\ m_{yj} \\ m_{zj} \end{matrix}\right\}$$ in local system



Sign convention for moments depends on whether right or left hand coordinate system is used. For right hand system right hand rule holds, for left hand system left hand rule holds.

Figure 11 Beam Element

ELEMENT No. 4



$x_\ell y_\ell$ - Local Axes

$x_p y_p$ - Local Property Axes

Nodes are numbered in counterclockwise fashion.

INPUT

Isotropic and Orthotropic

Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
No.	4				1	1	i	j	k		t		β		
* No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	

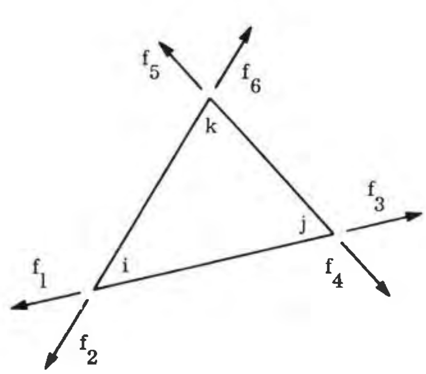
Anisotropic

Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
No.	4				1	1	i	j	k		t		β		
* No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	A_{23}
* No.					2	2					A_{13}				

*This card needed only when overriding program-stored properties.

OUTPUT

$$\begin{Bmatrix} f_1 \\ f_2 \\ f_3 \\ f_4 \\ f_5 \\ f_6 \end{Bmatrix}$$



Note:

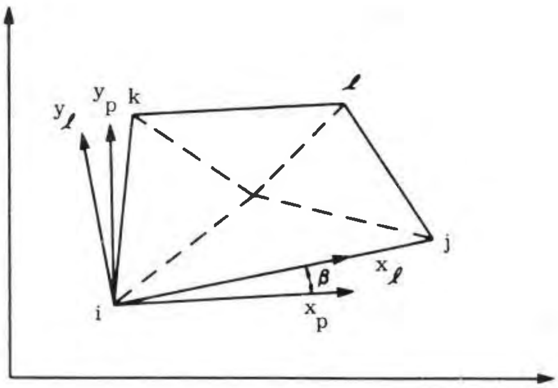
t = thickness of element
β given in degrees
β positive when x_p axis rotated away from the element
Elastic factors (A_{11} etc.) are elements of stress-strain law:

$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \begin{Bmatrix} \epsilon_x \\ \epsilon_y \\ \gamma_{xy} \end{Bmatrix}$$

Figure 12 Triangular Membrane Element

FASTOP–SOP–ASAM

ELEMENT No. 5



Element No. 5 is composed of four triangular elements.

$x_\ell \; y_\ell$ - **Local axes**

$x_p \; y_p$ - **Local property axes**

INPUT

Isotropic and Orthotropic

Member No.	Member Type	Matl. Code	Graphics	Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
No.	5				1	1	i	j	k	ℓ	t	β			
* No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	

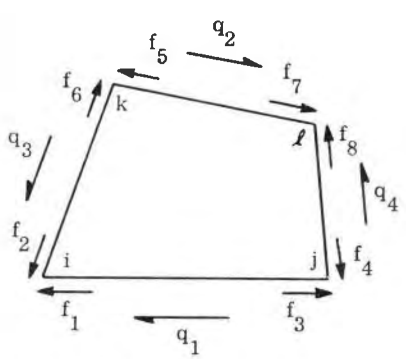
Anisotropic

Member No.	Member Type	Matl. Code	Graphics	Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
No.	5				1	1	i	j	k	ℓ	t	β			
* No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	A_{23}
* No.					2	2					A_{13}				

***This card needed only when overriding program-stored properties.**

OUTPUT

$$\begin{Bmatrix} f_1 \\ f_2 \\ f_3 \\ f_4 \\ f_5 \\ f_6 \\ f_7 \\ f_8 \\ q_1 \\ q_2 \\ q_3 \\ q_4 \end{Bmatrix}$$



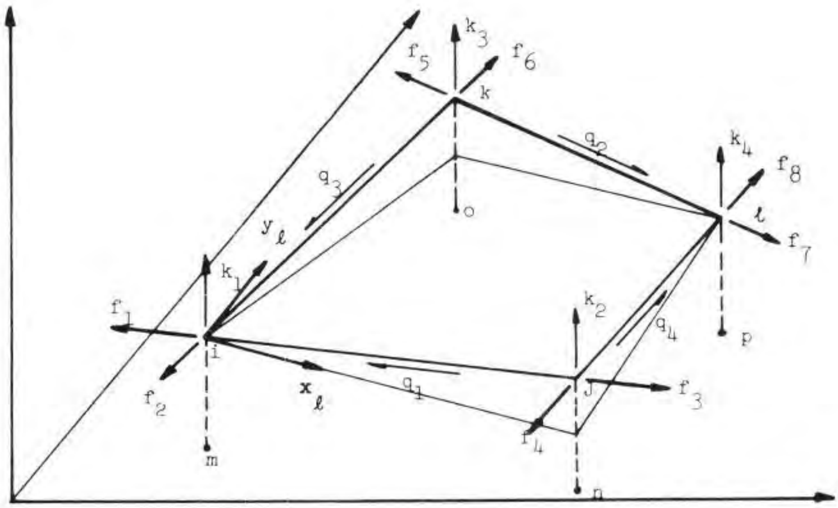
Note:

t = thickness of element
β given in degrees
β positive when x_p axis rotated away from the element
Elastic factors (A_{11} etc.) are elements of stress-strain law:

$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \begin{Bmatrix} \epsilon_x \\ \epsilon_y \\ \gamma_{xy} \end{Bmatrix}$$

Figure 13 Quadrilateral Membrane Element
FASTOP–SOP–ASAM

ELEMENT No. 6



Panel can be warped or planar

INPUT

Member No.	Member Type	Matl. Code	Graphics	Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
No.	6				1	1	i	j	k	ℓ	t				
No.					1	2	m	n	o	p					
No.					2	1					E	G			

t = thickness of panel
E = modulus of elasticity
G = shear modulus

OUTPUT

$$\left\{\begin{matrix} f_1 \\ f_2 \\ f_3 \\ f_4 \\ f_5 \\ f_6 \\ f_7 \\ f_8 \\ q_1 \\ q_2 \\ q_3 \\ q_4 \end{matrix}\right\} \quad \left[\begin{matrix} k_1 \\ k_2 \\ k_3 \\ k_4 \end{matrix}\right]$$

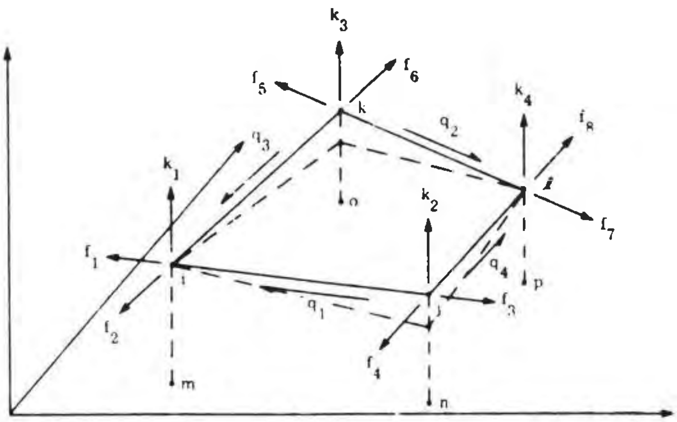
Note:

Nodes m, n, o, and p are optional (data card 12). They are used to specify the directions of the "kick"forces. When nodes m, n, o, and p are specified the direction of the "kick" forces is from i to m, from j to n, from r to o, and from ℓ to p. When these nodes are not specified (card 12 is left out), the direction of the "kick" forces is perpendicular to the two adjacent sides at a node and its sense is as shown above.

Figure 14 Quadrilateral Shear Panel (Garvey)

FASTOP–SOP–ASAM

ELEMENT No. 8



INPUT

Isotropic and Orthotropic

	Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	No.	8				1	1	i	j	k	ℓ	t	β			
*	No.					1	2	m	n	o	p					
**	No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	

Anisotropic

	Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	No.	8				1	1	i	j	k	ℓ	t	β			
*	No.					1	2	m	n	o	p					
**	No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	A_{23}
**	No.					2	2					A_{13}				

OUTPUT

$$\begin{Bmatrix} f_1 \\ f_2 \\ f_3 \\ f_4 \\ f_5 \\ f_6 \\ f_7 \\ f_8 \end{Bmatrix} \qquad \begin{vmatrix} q_1 \\ q_2 \\ q_3 \\ q_4 \\ k_1 \\ k_2 \\ k_3 \\ k_4 \end{vmatrix}$$

Note:

*Nodes m, n, o, p are optional (data card 12). They are used to specify the directions of the "Kick" forces. If data card 12 is left out, direction of "Kick" forces is perpendicular to adjacent sides at node and in the directions shown in the figure.

t = Thickness of element
β = Angle between property axes and side i-j; given in degrees.
Elastic factors (A_{11} etc.) are elements of stress strain law

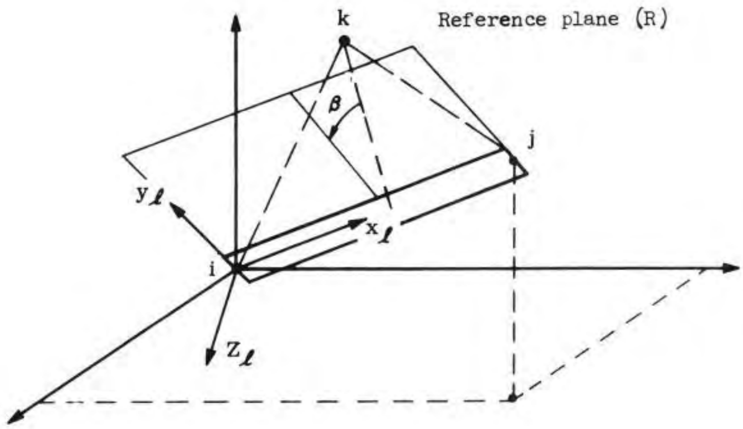
$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \begin{Bmatrix} \epsilon_x \\ \epsilon_y \\ \gamma_{xy} \end{Bmatrix}$$

**This card needed only when overriding program-stored properties.

Figure 15 Warped Quadrilateral

FASTOP–SOP–ASAM

ELEMENT No. 11



Hinge exists at node j on Z_ℓ axis

Nodes i, j, k determine reference plane R. Angle β determines orientation of y_ℓ, z_ℓ axes with respect to reference plane R.

INPUT

	Member No.	Member Type	Matl. Code	Graphics	Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	No.	11				1	1	i	j	k		Area	β	I_{yy}	I_{zz}	J
*	No.					2	1					E				

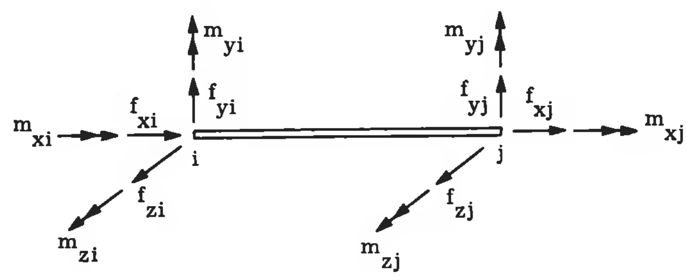
β is in degrees
J = Effective polar moment of inertia
E = Modulus of Elasticity

***This card needed only when overriding program-stored properties.**

OUTPUT

$$\left\{\begin{matrix} f_{xi} \\ f_{yi} \\ f_{zi} \\ m_{xi} \\ m_{yi} \\ m_{zi} \\ f_{xj} \\ f_{yj} \\ f_{zj} \\ m_{xj} \\ m_{yj} \\ m_{zj} \end{matrix}\right\}$$ **in local system**

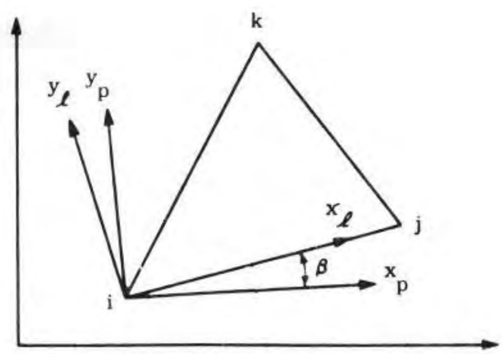
m_{z_j} should be zero



Sign convention for moments depends on whether right or left hand coordinate system is used. For right hand system right hand rule holds, for left hand system left hand rule holds.

Figure 16 Beam Element with Hinged End

ELEMENT No.15



$x_\ell\ y_\ell$ - Local Axes

$x_p\ y_p$ - Local Property Axes

Nodes are numbered in counterclockwise fashion.

INPUT

Isotropic and Orthotropic

Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
No.	15				1	1	i	j	k		t	β			
* No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	

Anisotropic

No.	15				1	1	i	j	k		t	β			
* No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	A_{23}
* No.					2	2					A_{13}				

***This card needed only when overriding program-stored properties.**

Note:

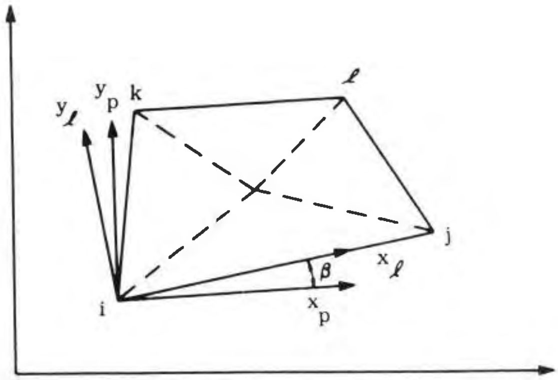
t = thickness of element
β given in degrees
β positive when x_p axis rotated away from the element
Elastic factors (A_{11} etc.) are elements of stress-strain law:

$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \begin{Bmatrix} \epsilon_x \\ \epsilon_y \\ \gamma_{xy} \end{Bmatrix}$$

Figure 17 Triangular Bending Element

FASTOP–SOP–ASAM

ELEMENT No.16



Element No. 16 is composed of four triangular elements.

$x_\ell \; y_\ell$ - Local axes

$x_p \; y_p$ - Local property axes

INPUT

Isotropic and Orthotropic

	Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	No.	16				1	1	i	j	k	ℓ	t	β			
*	No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	

Anisotropic

	Member No.	Member Type	Matl. Code		Const. Code	Data Class	Sub Class	Node 1	Node 2	Node 3	Node 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
	No.	16				1	1	i	j	k	ℓ	t	β			
*	No.					2	1					A_{11}	A_{22}	A_{33}	A_{12}	A_{23}
*	No.					2	2					A_{13}				

*This card needed only when overriding program-stored properties.

Note:

t = thickness of element
β given in degrees
β positive when x_p axis rotated away from the element
Elastic factors (A_{11} etc.) are elements of stress-strain law:

$$\begin{Bmatrix} \sigma_x \\ \sigma_y \\ \tau_{xy} \end{Bmatrix} = \begin{bmatrix} A_{11} & A_{12} & A_{13} \\ A_{21} & A_{22} & A_{23} \\ A_{31} & A_{32} & A_{33} \end{bmatrix} \begin{Bmatrix} \epsilon_x \\ \epsilon_y \\ \gamma_{xy} \end{Bmatrix}$$

Figure 18 Quadrilateral Bending Element

ATAM - AUTOMATED TRANSFORMATION ANALYSIS MODULE

I. PROGRAM APPLICATION

A. INTRODUCTION

THE PURPOSE OF THIS PROGRAM IS TO CREATE TRANSFORMATION MATRICES THAT ARE USED TO RELATE LOADS AND DISPLACEMENTS IN A GIVEN MATHEMATICAL MODEL TO EQUIVALENT LOADS AND DISPLACEMENTS IN ANOTHER MODEL. THESE MATRICES THUS PROVIDE A MEANS FOR TRANSFERRING DATA GENERATED BY ONE TECHNICAL DISCIPLINE, IN ITS COORDINATE SYSTEM, TO A SECOND TECHNICAL DISCIPLINE, IN ITS PARTICULAR COORDINATE SYSTEM. THE TRANSFORMATIONS ARE ACCOMPLISHED BY CREATING A SYSTEM OF BEAMS WHICH STATICALLY BRIDGE LOADS IN ONE SYSTEM TO EQUIVALENT LOADS AT DIFFERENT LOCATIONS IN THE SECOND SYSTEM. THREE MAJOR BLOCKS OF INFORMATION ARE REQUIRED, NAMELY, THE NODAL GEOMETRIES OF THE TWO SYSTEMS, AND A CORRESPONDENCE TABLE WHICH INDICATES HOW THE INDIVIDUAL LOADS SHOULD BE BEAMED.

B. TECHNICAL DISCUSSION

THE TRANSFORMATION MATRIX GENERATOR CREATES TRANSFORMATION MATRICES WHICH EXPRESS THE LOADS ON ONE MODEL (OUTPUT COORDINATE SYSTEM - MODEL B) IN TERMS OF APPLIED UNIT LOADS ON ANOTHER MODEL (INPUT COORDINATE SYSTEM - MODEL A). THESE TRANSFORMATIONS ARE CREATED BY ESTABLISHING A BEAMING SYSTEM WHICH BRIDGES THE APPLIED LOAD BETWEEN MODELS. FOR EVERY NODE IN MODEL A, A BEAMING SYSTEM IS CREATED WHICH CAN BRIDGE ANY OR ALL SIX COMPONENTS OF LOAD AT A PARTICULAR NODE TO SPECIFIED NODES IN MODEL B. THE PROGRAM REQUIRES THE NODAL GEOMETRIES OF MODELS A AND B, AND A CORRESPONDENCE TABLE THAT INDICATES THE MANNER OF BEAMING AND THE NODES TO WHICH THE A LOADS ARE TO BE TRANSFERRED ON THE B MODEL. THREE TYPES OF BEAMING MECHANISMS EXIST, NAMELY,

1. SIMPLE BEAMING
2. CANTILEVER BEAMING
3. UNIT BEAMING

THE FIRST TWO BASIC BEAMING MECHANISMS ARE SHOWN IN FIGURES 1 AND 2. THE SIMPLE BEAMING MECHANISM IS USED WHERE THE NODE M LIES WITHIN THE MAIN STRUCTURAL SYSTEM WHILE THE CANTILEVER BEAMING IS USED WHERE THE LOADS ARE OUTSIDE THE STRUCTURAL BOX. IN EITHER CASE IT IS NOT NECESSARY FOR THE NODE M TO LIE GEOMETRICALLY BETWEEN THE STRUCTURAL NODES. THAT IS, IN THE SIMPLE BEAMING CASE M CAN LIE OUTSIDE OF THE SHADED REGION AND IN THE CANTILEVER GASE POINT G NEED NOT BE WITHIN THE SHADED

REGION. IN BUILDING THE TRANSFORMATION MATRICES CERTAIN ASSUMPTIONS HAVE BEEN MADE IN ORDER TO MAKE THE SYSTEM STATICALLY DETERMINATE. THESE ASSUMPTIONS ARE.

1. SIMPLE BEAMING

1. THE NODES MAY HAVE A GENERAL ORIENTATION IN SPACE.

2. THE LINE E-F IS PERPENDICULAR TO THE LINE A-B WHILE G-H IS PARALLEL TO A-B.

3. THE POINT M FORMS THE ORIGIN OF A LOCAL X-Y-Z ORTHOGONAL LEFT HAND COORDINATE SYSTEM.

4. LOCAL LOADS PX, PY, PZ AND MY ARE SIMPLE BEAMED ALONG THE LINE E-F TO POINTS E AND F AND THEN SIMPLE BEAMED TO POINTS A, B, C AND D. FROM THESE POINTS THE LOADS ARE AGAIN SIMPLE BEAMED TO THE STRUCTURAL NODES I, J, K, L, N, O, P, AND Q.

5. LOCAL LOADS MX AND MZ FOLLOW A SIMILAR PATH EXCEPT THAT THEY ARE BEAMED ALONG G-H AND THEN TO A, B, C AND D BY USING A-C AND B-D AS SIMPLE BEAMS.

6. ALL APPLIED LOAD MOMENTS ARE INITIALLY TRANSFORMED TO COUPLES AS THE FIRST STEP IN BEAMING.

7. ONLY FORCE COMPONENTS ARE PLACED ON THE STRUCTURAL NODES. THE APPLIED MOMENTS ARE TRANSFORMED INTO A STATICALLY EQUIVALENT FORCE SYSTEM.

8. LOADS PARALLEL TO A BEAMING ELEMENT ARE PROPORTIONED TO THE END POINTS IN ACCORDANCE WITH GEOMETRIC DISTANCES (HALF FACTORS ARE NOT USED).

9. THE BEAMING PLANE A-B-C-D IS PARALLEL TO THE X-Y PLANE OF THE STRUCTURES MODEL.

10. ALL APPLIED LOADS AT POINT M, AS SHOWN IN FIGURE 1, ARE EXPRESSED IN TERMS OF UNIT VALUES OF LOADS AND MOMENTS THAT ARE IN THE SAME COORDINATE SYSTEM AS THE GEOMETRY OF POINT M.

2. CANTILEVER BEAMING

1. ASSUMPTIONS 1, 7 AND 10, USED IN SIMPLE BEAMING, ALSO APPLY TO CANTILEVER BEAMING.

2. POINTS I, J, K AND L NEED NOT LIE IN A PLANE.

3. THE REFERENCE PLANE IS PARALLEL TO THE VECTORS I-L AND K-J

AND CONTAINS THE POINTS E AND F WHICH ARE MIDWAY BETWEEN I AND K AND J AND L RESPECTIVELY. THE LINE G-M IS PERPENDICULAR TO THE LINE E-F. POINTS A, B, C AND D ARE PROJECTIONS OF POINTS I, J, K AND L ON THE REFERENCE PLANE.

4. POINT M IS CAPABLE OF RESISTING 6 COMPONENTS OF LOAD WHICH ARE TRANSFORMED TO POINT G IN A CANTILEVER FASHION. MEMBER E-F ACTS LIKE A BEAM THAT IS CAPABLE OF RESISTING BENDING, AXIAL LOAD AND TORSION, THE TORSIONAL RESISTANCE AT E AND F LYING IN THE PLANES I-K-A-C AND J-L-D-B. THE LOADS AT POINT E AND F ARE THEN TRANSMITTED TO THE STRUCTURAL NODES BY ASSUMING THAT MEMBERS I-K AND J-L ARE PIN SUPPORTED AT THE END AND ARE LOADED AT E AND F BY THREE FORCES AND A CONCENTRATED MOMENT.

5. POINT G NEED NOT BE BETWEEN E AND F. WHEN IT LIES OUTSIDE THESE POINTS, THE TORSIONAL LOAD IS RESISTED BY THE NEAREST PAIR OF STRUCTURAL NODES.

3. UNIT BEAMING

UNIT BEAMING IS USED WHEN A DYNAMIC AND STRUCTURAL NODE ARE COINCIDENT AND WHEN THE REQUIRED DYNAMIC NODE DEGREES OF FREEDOM ARE THE SAME AS THE DEGREES OF FREEDOM OF THE STRUCTURAL NODE. UNIT BEAMING THEREFORE ALLOWS THE USER TO DIRECTLY SPECIFY UNIT 'BEAMED' LOADS AT STRUCTURES MODEL NODE POINTS.

THE ACTUAL USE OF THESE BEAMING MECHANISMS IS BEST ILLUSTRATED BY CONSIDERING A SMALL EXAMPLE AS SHOWN IN FIGURE 3. THE AERO NODE POINTS ARE NUMBERED FROM 1 TO 81 AND LIE ON THE AERO REFERENCE PLANE, THE STRUCTURE CONTAINS 48 NODES NUMBERED FROM 1 TO 48 WHERE ALL ODD NUMBERED NODES ARE ON THE TOP SKIN. IT WILL BE ASSUMED THAT ONLY THE PRIMARY BOX IS OF INTEREST AND THUS ALL LOADS MUST BE BRIDGED TO IT. FOR THE SAKE OF ILLUSTRATION THE WING IS COMPOSED OF TWO OVERSIMPLIFIED CONTROL SURFACES THAT HAVE HINGE POINTS AT SPECIFIC POINTS ON THE STRUCTURE. THUS APPLIED LOADS ON THE CONTROL SURFACES WILL ACT ON THE WING BOX IN A CONCENTRATED FASHION. FIGURE 4 SHOWS SECTION A-A OF THE WING AND ILLUSTRATES THE LOCATION OF THE REFERENCE PLANE AS WELL AS AN EXTERNAL STORE THAT HANGS OFF THE STRUCTURE AT RIB NUMBER 2. AERO NODE NUMBER 12 IS TYPICAL OF A POINT THAT WOULD USE THE SIMPLE BEAMING MECHANISM TO BRIDGE THE LOAD TO STRUCTURAL NODES 1, 3, 7, 9 ON THE TOP SKIN AND 2, 4, 8 AND 10 ON THE BOTTOM. AERO NODE NUMBER 13 WOULD BE BEAMED TO THE IDENTICAL STRUCTURAL NODES AS 12. THE ORDER OF THE STRUCTURAL NODE CALL OUT IS IMPORTANT. THE SEQUENCE I, J, K AND L AS INDICATED IN FIGURE 1 MUST BE FOLLOWED, THE PROGRAM ASSUMES THAT N, O, P AND Q ARE ONE GREATER IN NODE NUMBER THAN I, J, K AND L. THIS IS CONSISTENT WITH THE INFORMATION ON NODE NUMBERING GIVEN IN THE ASAM/ASOM SECTION OF THE USER'S MANUAL. NOTE ALSO THAT THE NORMAL LOAD IS BEAMED ALONG LINE E-F (IN FIGURE 1) WHICH IS PERPENDICULAR TO A-B. THUS IF THE NODES I, J, K AND L ARE CALLED OUT AS 1, 3, 7

AND 9. THE LOAD WILL BE BRIDGED TO THE TWO RIBS BY A BEAM THAT IS NORMAL TO THEM. THE LOAD WILL THEN BE REDISTRIBUTED BY THE RIBS (LINES A-B AND C-D IN FIGURE 1) TO NODES 1, 2, 3 AND 4 ON ONE RIB AND 7, 8, 9 AND 10 ON THE SECOND. IF THE LOWER COVER NODES ARE NOT ONE GREATER IN NODE NUMBER THAN THE UPPER COVER IT IS POSSIBLE TO USE A SECOND VERSION OF THE SIMPLE BEAMING SCHEME WHERE ALL EIGHT NODES ARE INDICATED. THIS SECOND VERSION IS DESIGNATED 'B'. THE CANTILEVER BEAMING MECHANISM WHICH IS DESIGNATED AS BEAMING TYPE 'C' IS USED TO BRIDGE OVERHANG LOADS INTO THE STRUCTURAL BOX. FOR EXAMPLE, AERO NODES 1, 2, 10 AND 11 CAN BE BRIDGED TO STRUCTURAL NODES 1, 7, 2 AND 8. AGAIN THE ORDER OF THE NODAL CALL OUT IS IMPORTANT AND MUST FOLLOW THE ARRANGEMENT INDICATED IN FIGURE 2. LOADS ON THE CONTROL SURFACE SUCH AS 7, 8, 9, 16, 17, 18, 25, 26 AND 27 MAY BE BRIDGED TO STRUCTURAL NODES 5, 17, 6 AND 18 BY THE CANTILEVER MECHANISM. IT IS THUS SEEN THAT THE ABILITY TO SPECIFY THE NODE WHICH APPLIED LOADS MUST BE BEAMED TO IS IMPORTANT. SETTING UP A BEAMING SCHEME BASED ON THE NEAREST GEOMETRIC POINTS IS NOT WHAT IS REQUIRED. IT IS ALSO IMPORTANT TO REALIZE THAT THE METHOD OF BEAMING THE LOADS FORM THE CONTROL SURFACE DOES NOT RECOGNIZE THE REDUNDANCY IN THE ATTACHMENT POINTS BETWEEN THE CONTROL SURFACE AND THE WING. A SIMPLE APPROACH OF BEAMING THE CONTROL SURFACE LOADS TO THE NEAREST HINGE POINTS SEEMS JUSTIFIED SINCE ANY METHOD TO ACCOUNT FOR REDUNDANCY BY CONSIDERING, LET US SAY, A THREE BEAM SUPPORT WOULD NOT ACCOUNT FOR THE DEFLECTION OF THESE SUPPORTS. THIS COULD COMPLETELY ALTER THE DISTRIBUTION. IF IT IS DESIRED TO ACCOUNT FOR THESE EFFECTS THEN THE CONTROL SURFACE STRUCTURE MUST BE INCLUDED IN THE STRUCTURAL IDEALIZATION.

FIGURE 4 SHOWS AN EXTERNAL STORE THAT IS ATTACHED TO THE MAIN STRUCTURE BY A PYLON. THE MECHANISM FOR BRIDGING THIS LOAD IS ILLUSTRATED IN FIGURE 5. THIS MECHANISM WILL, OF COURSE, NOT RECOGNIZE THE ELASTICITY OF THE PYLON.

THE BEAMING MECHANISMS THAT JUST HAVE BEEN DESCRIBED ARE CAPABLE OF BEAMING ANY TYPE OF LOAD TO THE STRUCTURAL SYSTEM. TYPES OF LOADS ARE CLASSIFIED ACCORDING TO THE PARTICULAR MATHEMATICAL MODEL IN WHICH THEY OCCUR AND IT REQUIRES ONE TRANSFORMATION MATRIX PER MODEL. THUS, IT MAY REQUIRE AS MANY AS THREE TRANSFORMATION MATRICES TO BRIDGE ALL OF THE TYPES OF LOADS (AERODYNAMIC, INERTIAL, DYNAMIC) THAT ARE PLACED ON THE WING.

C. TYPES OF TRANSFORMATION MATRICES GENERATED

EACH TRANSFORMATION MATRIX THAT IS GENERATED REQUIRES TWO SETS OF GEOMETRY, THE INPUT GRID GEOMETRY AND THE OUTPUT GRID GEOMETRY WHICH IS THE STRUCTURES GEOMETRY. IN ADDITION EACH TRANSFORMATION MATRIX REQUIRES THAT A CORRESPONDENCE TABLE BE PROVIDED WHICH TABULATES THE TYPE OF INFORMATION THAT HAS BEEN DISCUSSED PREVIOUSLY. USING THESE CORRESPONDENCE TABLES AND THE GEOMETRY OF THE TWO MODELS THE PROGRAM IS CAPABLE OF GENERATING

THE FOLLOWING TRANSFORMATIONS.

1. AERODYNAMICS GRID TRANSFORMATION MATRIX - EXPRESSES STRUCTURAL LOADS IN TERMS OF UNIT LOADS IN THE AERODYNAMICS MODEL.

2. WEIGHTS GRID TRANSFORMATION MATRIX - EXPRESSES STRUCTURAL LOADS IN TERMS OF UNIT LOADS IN THE WEIGHTS MODEL.

3. DYNAMICS GRID TRANSFORMATION MATRIX - EXPRESSES STRUCTURAL LOADS IN TERMS OF UNIT LOADS IN THE DYNAMICS GRID.

SINCE THE AERODYNAMIC LOADS ROUTINE ONLY CALCULATES THE LOADS IN THE Z (OUT-OF-PLANE) DIRECTION, THEN THE LOAD BEAMING IS ONLY SPECIFIED FOR THE FZ COMPONENTS. FOR THE WEIGHTS AND DYNAMICS GRIDS, THE NUMBER OF COMPONENTS OF LOAD AT A NODE IS SELECTED BY THE USER (MAXIMUM OF 6, FX, FY, FZ, MX, MY, MZ) AND LOAD BEAMING MUST BE SPECIFIED ACCORDINGLY.

THE OUTPUT MATRIX GIVES THE CORRESPONDENCE BETWEEN THE STRUCTURAL (OUTPUT COORDINATE SYSTEM) NODE FORCE AND THE INPUT COORDINATE SYSTEM (AERODYNAMICS, WEIGHTS AND DYNAMICS GRIDS) NODE LOADS. THE ROW 'LINEUP' OF THE OUTPUT MATRIX DEPENDS ON THE NUMBER OF UNIT FORCES AND MOMENTS CHOSEN - NUMBER OF ONE'S PLACED IN THE CORRESPONDENCE TABLE.

THE INPUT-OUTPUT RELATIONSHIP FOR THE PARTIAL AND FULL TRANSFORMATION MATRICES USING THE DYNAMICS GRID AS AN EXAMPLE AND INCLUDING SIMPLE AND CANTILEVER BEAMING IS GIVEN IN FIGURES 6 AND 7. IN THE FIGURES THE COLUMN LINEUP FOR THE STRUCTURAL NODE COMPONENTS IS IN GROUPS OF THREE REPRESENTING THE OUTPUT FORCE COMPONENTS, FX, FY, AND FZ. IN THE CASE OF UNIT BEAMING (USED IN THE DYNAMICS GRID TRANSFORMATION MATRIX) WHERE THE MOMENT COMPONENTS ARE INCLUDED, THE COLUMN LINEUP WILL BE IN GROUPS OF SIX FOR EVERY STRUCTURAL NODE WHICH INCLUDES UNIT BEAMING. SPECIFICALLY THE COLUMN GROUP OF THREE OR SIX WILL DEPEND UPON THE FOLLOWING CONDITIONS.

1. FORCE COMPONENTS ONLY - FOR UNIT BEAMING WHERE ONLY THE UNIT FORCE COMPONENTS (EITHER FX, FY, FZ OR ANY COMBINATION OF THE THREE) ARE APPLIED THE STRUCTURAL NODE GROUP WILL HAVE THREE COLUMNS ASSOCIATED WITH THE FORCE COMPONENTS.
2. FORCE AND MOMENT COMPONENTS - FOR UNIT BEAMING WHERE IN ADDITION TO THE UNIT FORCE COMPONENTS MOMENT COMPONENTS ARE APPLIED (EITHER MX, MY, MZ OR ANY COMBINATION OF THE THREE) THE STRUCTURAL NODE GROUP WILL HAVE SIX COLUMNS ASSOCIATED WITH THE FORCE AND MOMENT COMPONENTS.
3. MOMENT COMPONENTS ONLY - FOR UNIT BEAMING WHERE THERE ARE NO UNIT FORCES BUT THERE ARE UNIT MOMENTS, THE STRUCTURAL NODE GROUP WILL HAVE SIX COLUMNS ASSOCIATED WITH THE FORCE AND

MOMENT COMPONENTS, BUT THE FORCE COMPONENTS WILL HAVE ZERO VALUES.

NOTE THAT A STRUCTURAL NODE TO WHICH UNIT BEAMING IS APPLIED (ONLY APPLICABLE TO THE DYNAMICS MODEL) CANNOT BE USED FOR SIMPLE OR CANTILEVER BEAMING FOR ANY OTHER DYNAMIC NODE. NOTE ALSO THAT UNIT BEAMING OF MOMENT COMPONENTS MUST ONLY BE SELECTED AT STRUCTURAL NODES THAT ARE CAPABLE OF RESISTING A DIRECT APPLIED MOMENT, E.G. A BEAM ELEMENT NODE.

D. COORDINATE SYSTEMS

FOR ALL TRANSFORMATION MATRICES THE APPLIED UNIT LOADS ARE ALWAYS IN THE COORDINATE SYSTEM OF THE PARTICULAR MODEL TO WHICH LOADS ARE BEING APPLIED.

THE STANDARD (LEFT HAND RULE) SIGN CONVENTION USED IN THE TRANSFORMATION ANALYSIS FOR BOTH THE AERODYNAMICS AND INERTIAL LOADS IS SHOWN IN FIGURE 8. THE FLUTTER SIGN CONVENTION USED FOR THE DYNAMICS MODEL IS SHOWN IN FIGURE 9, WHERE THE STANDARD SIGN CONVENTION IS SUPERIMPOSED AS DASHED LINES.

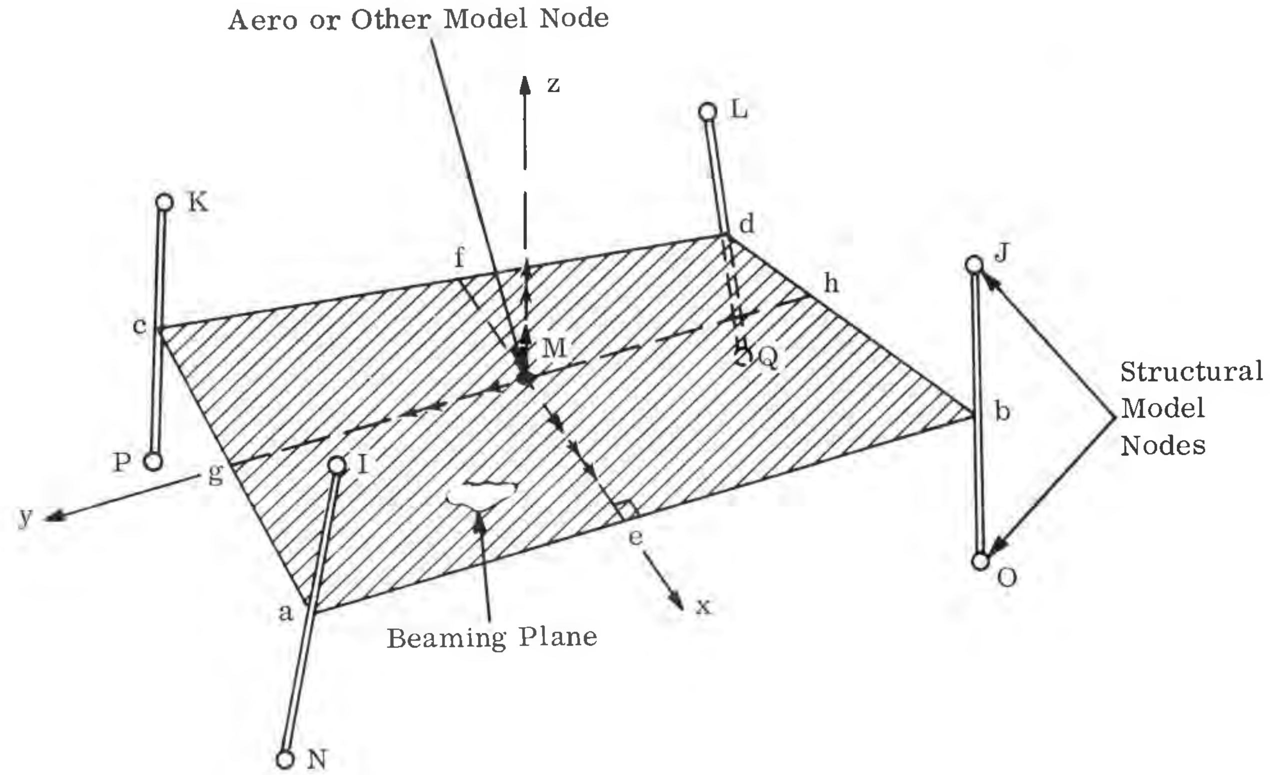


Figure 1a Simple Beaming Mechanism

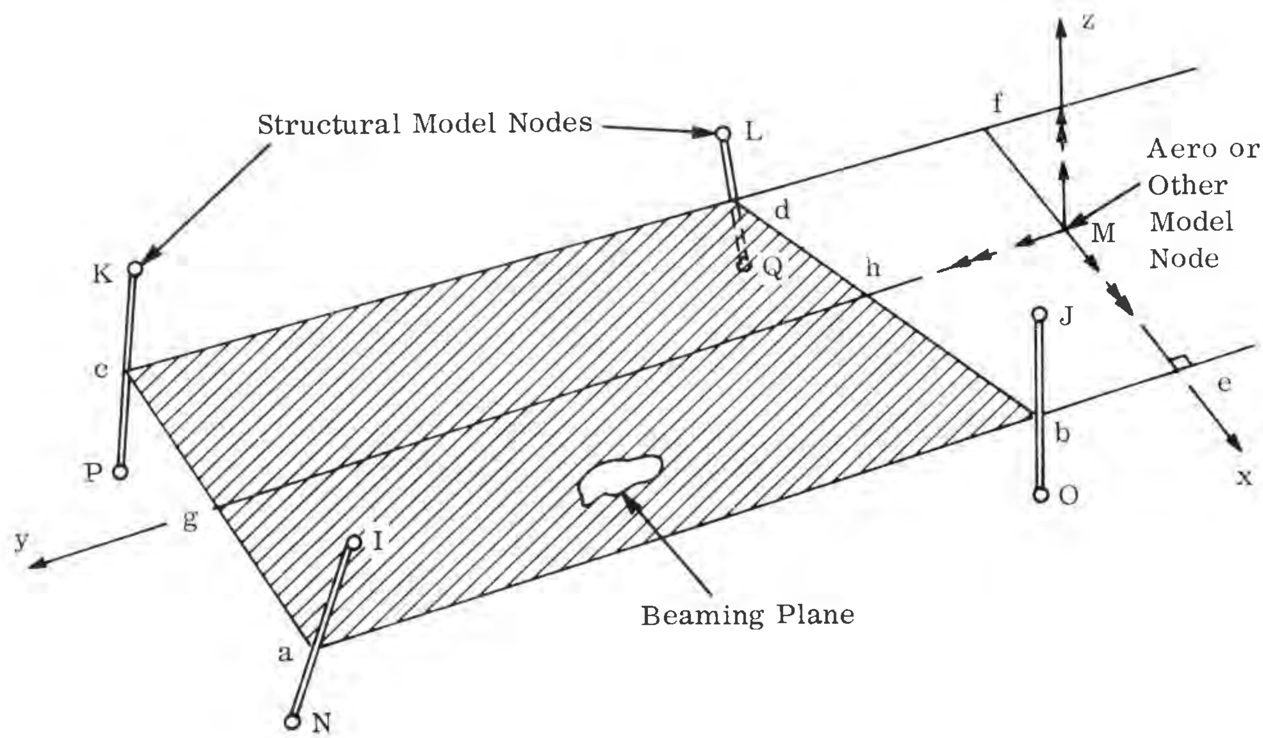


Figure 1b Simple Beaming Mechanism for Loads not Between Structural Nodes

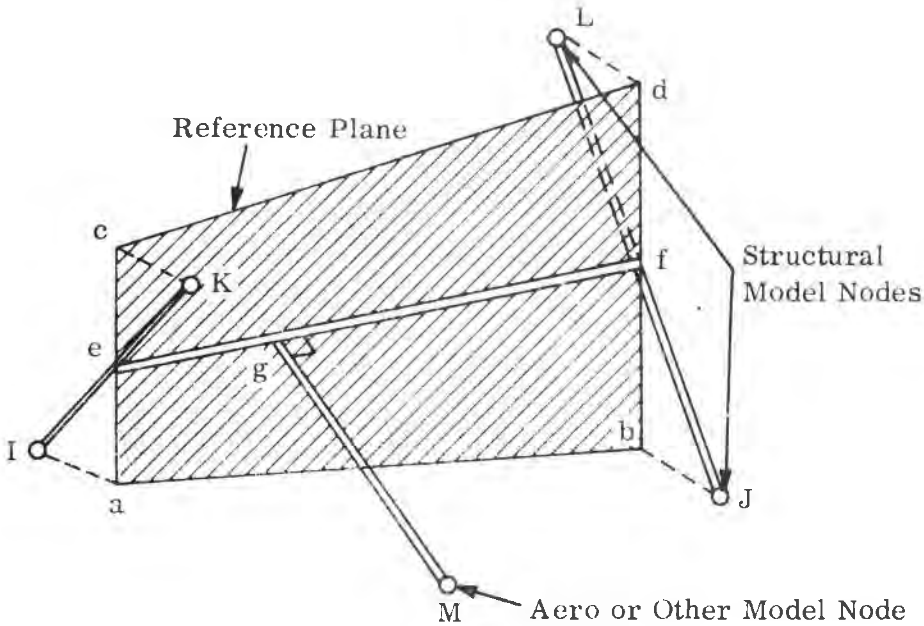


Figure 2a Cantilever Beaming

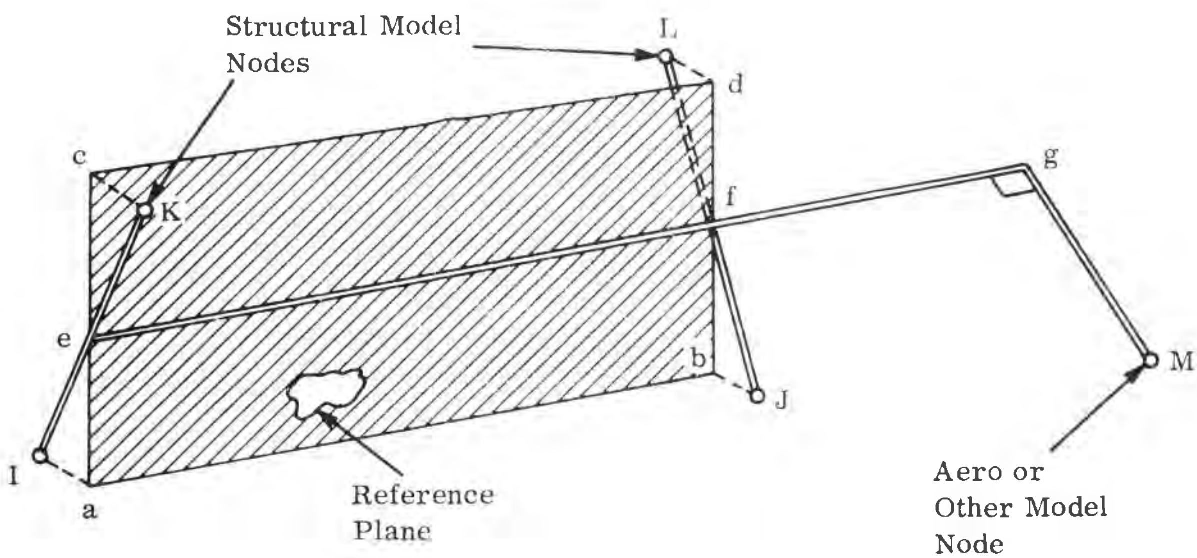
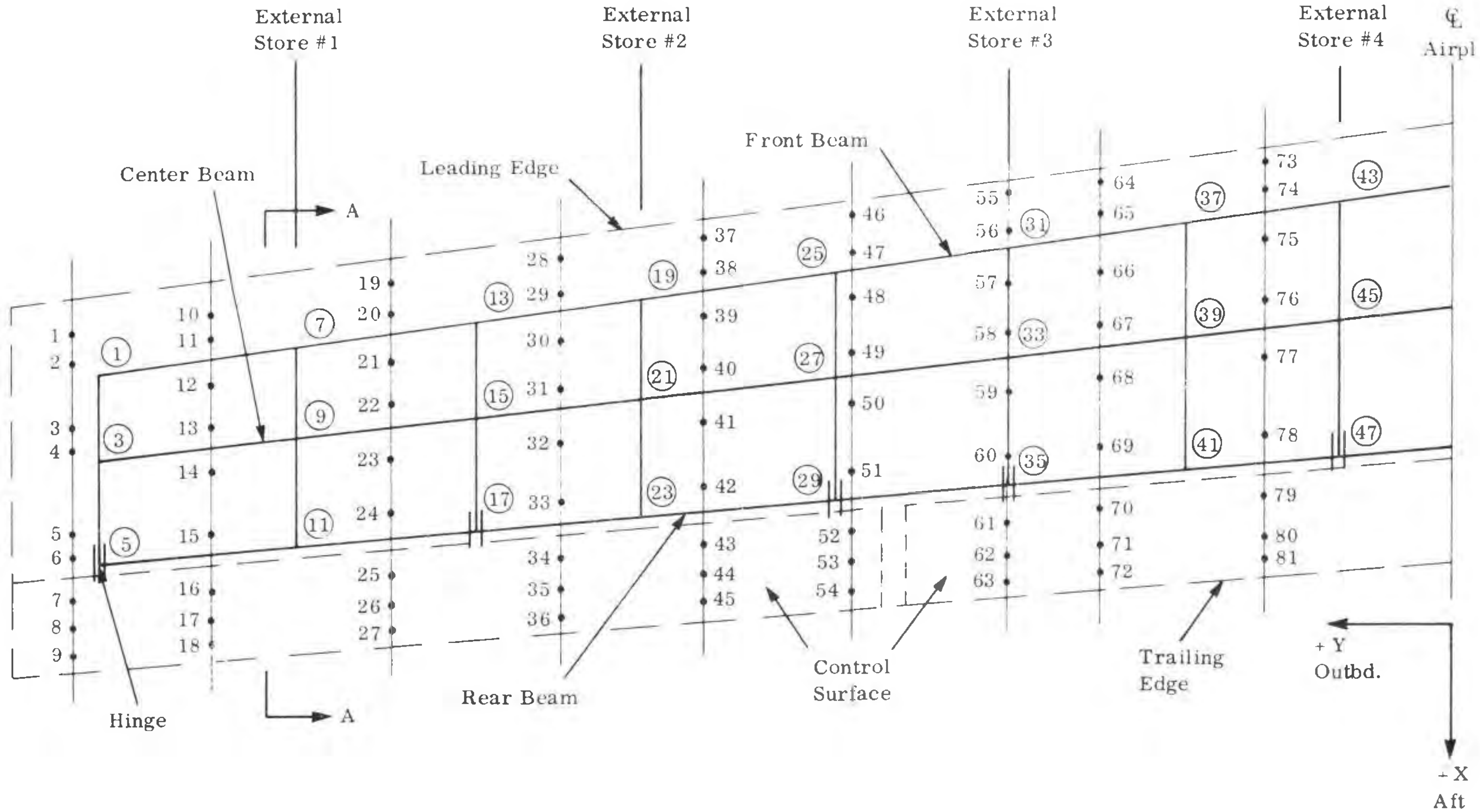


Figure 2b Cantilever Beaming Mechanism for Loads Not Between Structural Nodes



Note: Circled numbers indicate structural nodes.
Uncircled numbers indicate aero nodes.

Figure 3 Example Wing

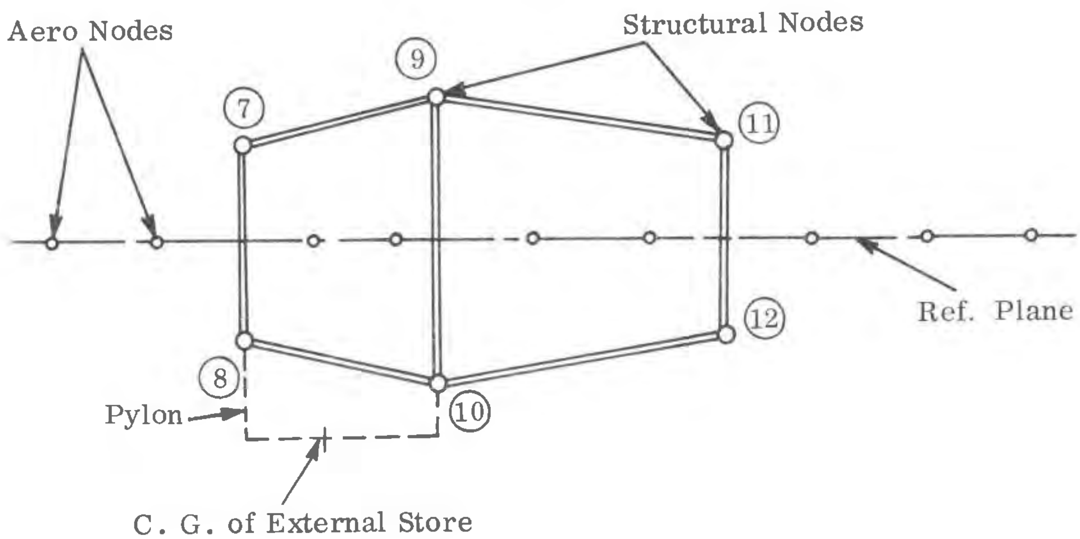


Figure 4 Section A-A of Example Wing

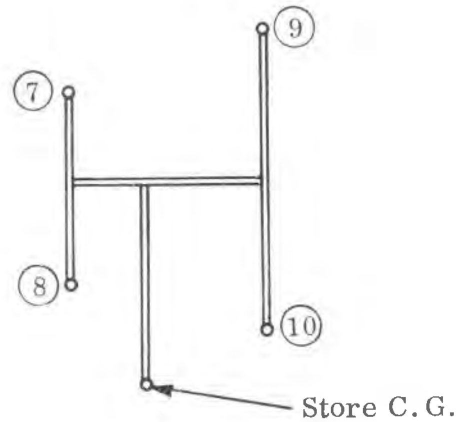
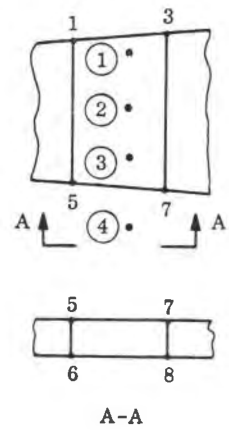


Figure 5 Mechanism for Beaming External Store

INPUT

Dynamic Node No.		Struct. Nodes i	j	k	ℓ	Type	Dynamic Node Component F_x	F_y	F_z	M_x	M_y	M_z
1		5	7	1	3	B			1			
2		5	7	1	3	B			1			
3		5	7	1	3	B			1			
4		6	8	5	7	C	1	1	1			

Correspondence Table



OUTPUT

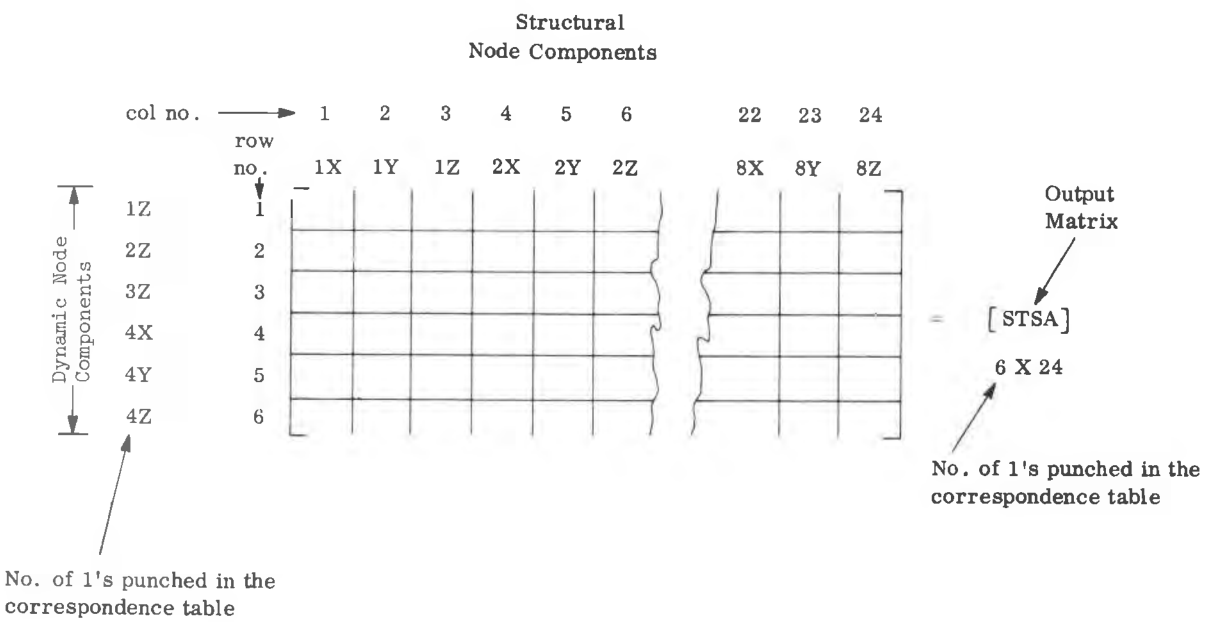
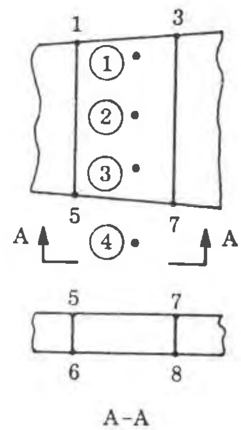


Figure 6 Input-Output Relationship for Partial Transformation Matrix

INPUT

Dynamic Node No.		Struct. Nodes i	j	k	ℓ	Type	Dynamic Node Component F_x	F_y	F_z	M_x	M_y	M_z
1		5	7	1	3	B	1	1	1			
2		5	7	1	3	B	1	1	1			
3		5	7	1	3	B	1	1	1			
4		6	8	5	7	C	1	1	1			

Correspondence Table



OUTPUT

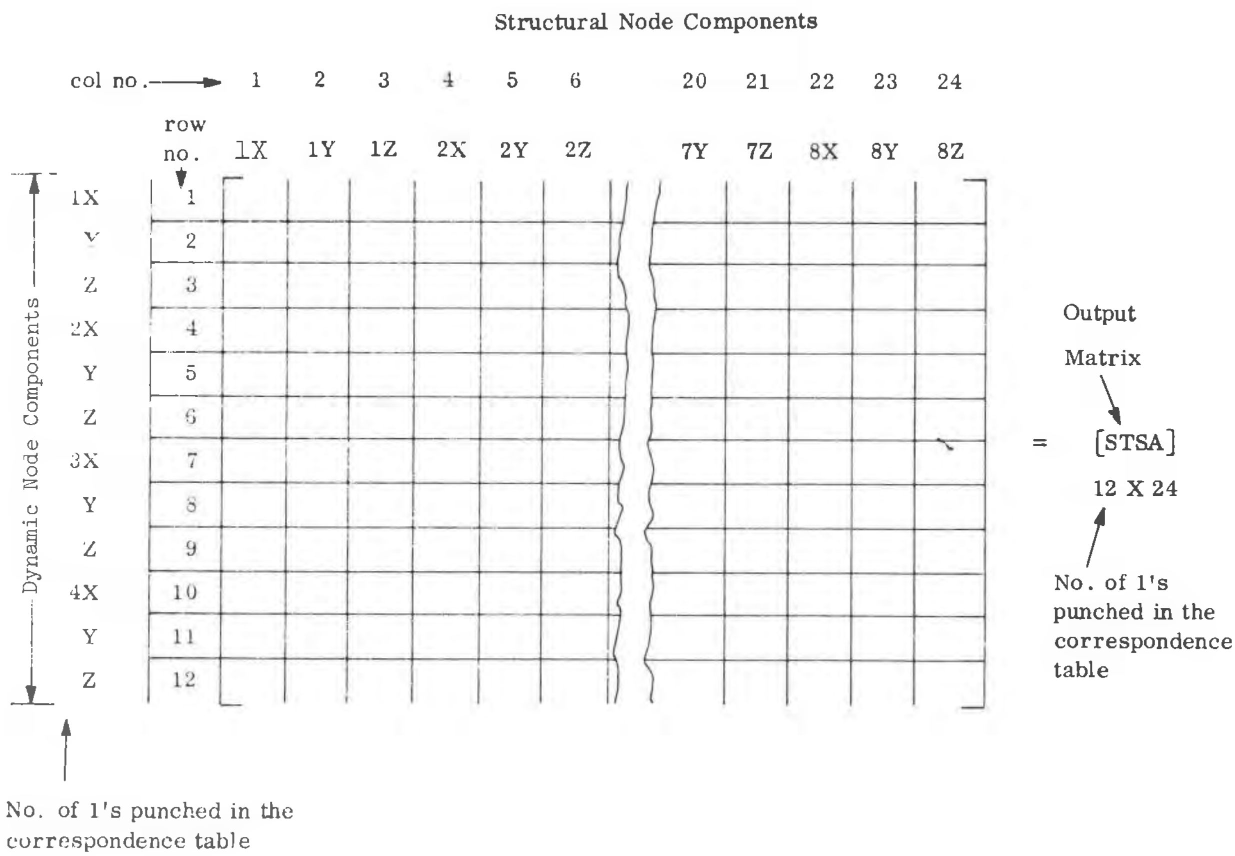


Figure 7 Input-Output Relationship for Full Transformation Matrix

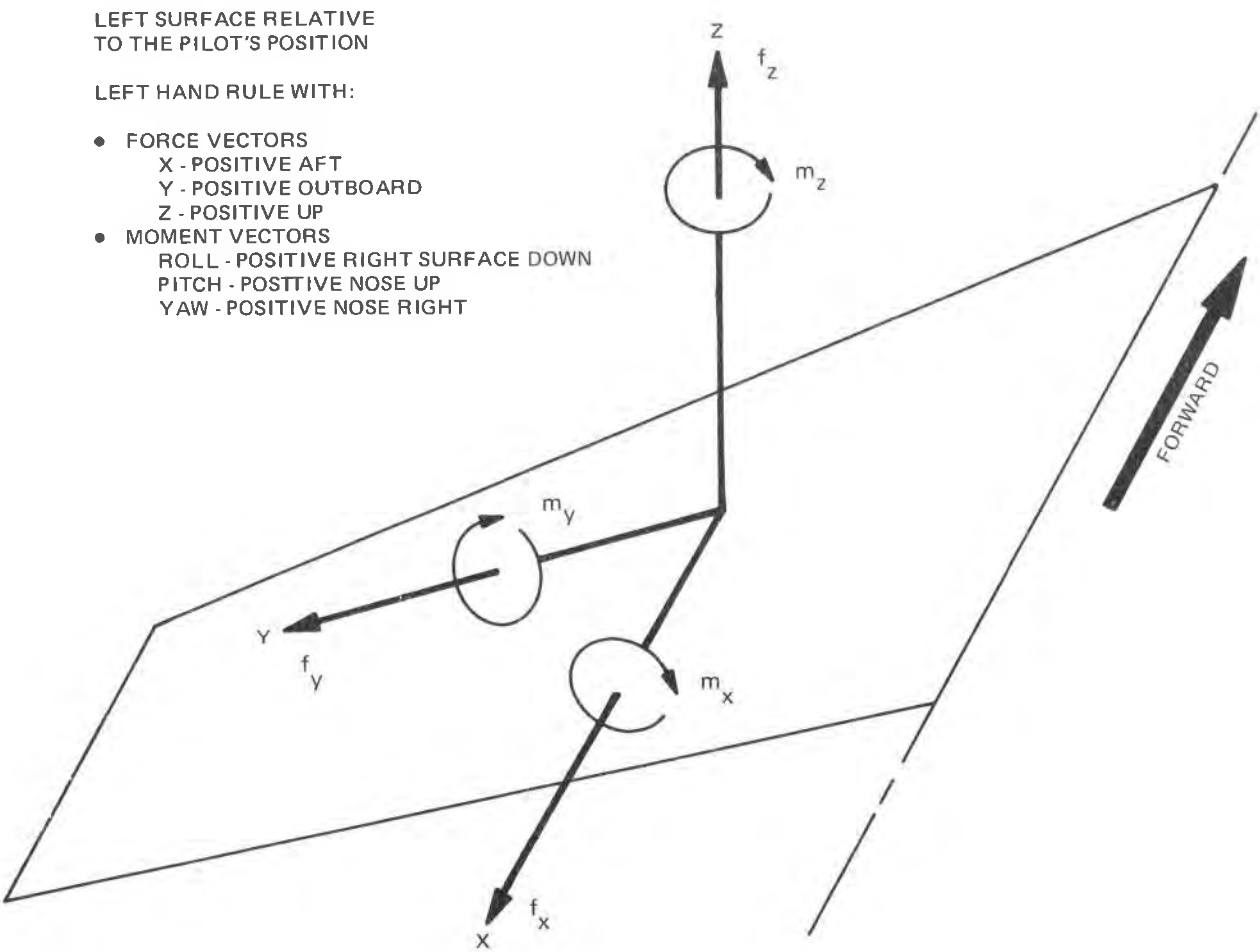


Figure 8 Aerodynamic and Inertial Loads Analysis Sign Convention

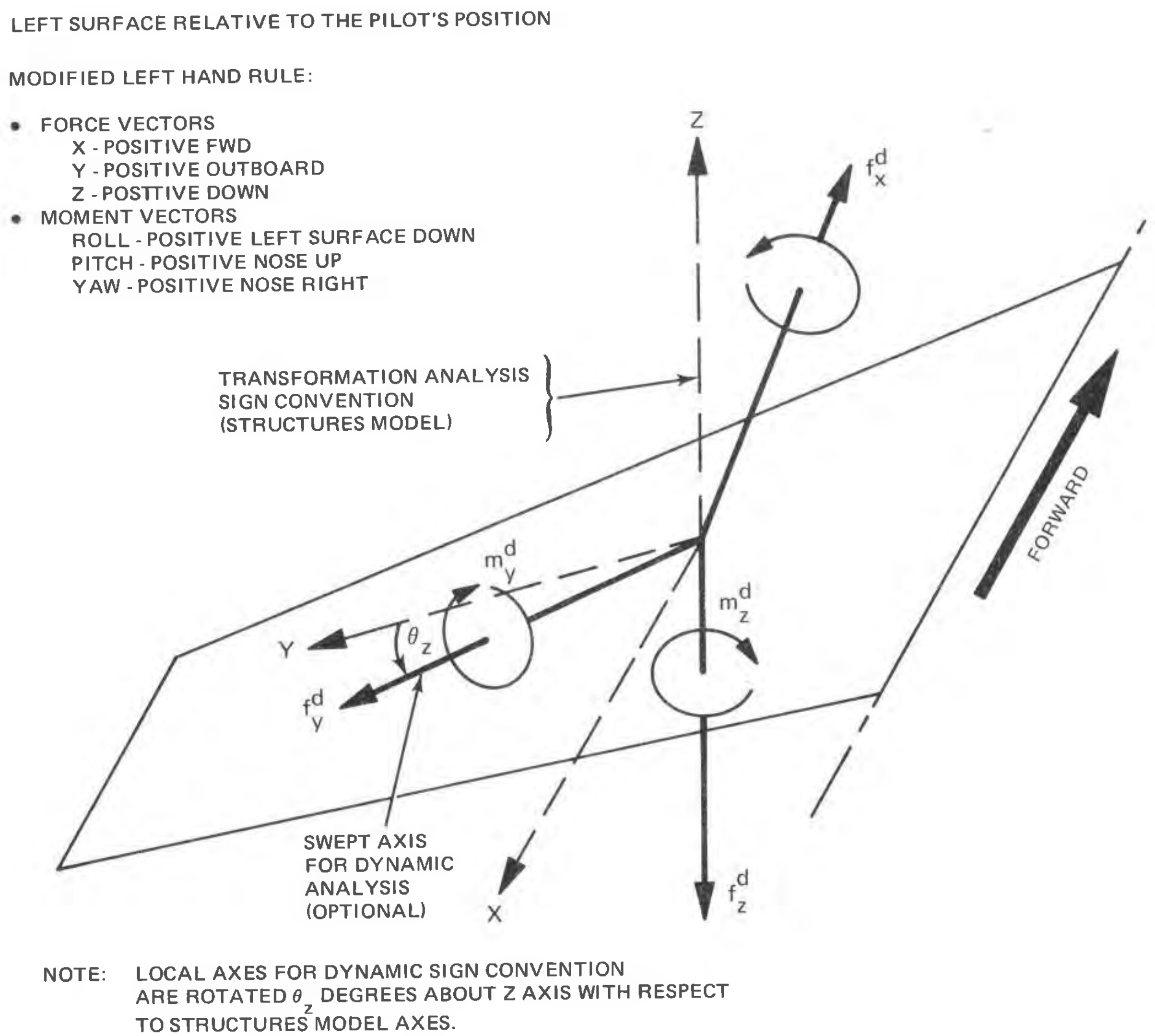


Figure 9 Dynamic Analysis Sign Convention

INPUT

MAIN PROGRAM (SOP)

I. CONTROL WORD OPTION DESCRIPTION

THE AVAILABLE OPTIONS TO EXECUTE THE STRENGTH OPTIMIZATION PROGRAM IN WHOLE OR IN PART OR TO INTRODUCE SIMPLIFICATIONS, ARE EXERCISED THROUGH CERTAIN CONTROLS ENTERED AS CARD DATA. THE GENERAL VARIABLE KLUE(I) REPRESENTS THE DATA CONTROL WORD OPTIONS USED TO STORE INFORMATION READ FROM CARDS. A ZERO VALUE IS USED FOR ELIMINATING THE OPTIONS WHEREAS A VALUE CORRESPONDING TO THE INDEX ASSOCIATED WITH THE SEQUENTIAL NUMBER OF THE VARIABLE, KLUE(I), IS USED FOR EXERCISING THE OPTION. IN ORDER TO MINIMIZE THE AMOUNT OF DATA THE USER MUST PROVIDE, THE CONTROL WORD OPTION KLUE(I) IS INITIALIZED TO ZERO WITHIN THE PROGRAM. THE USER IS REQUIRED TO PROVIDE DATA ONLY FOR THOSE OPTIONS HE WANTS EXERCISED PUNCHED WITH FOUR COLUMNS EACH AND RIGHT JUSTIFIED WITH THE CONDITION THAT THE LAST CONTROL WORD OPTION MUST BE NEGATIVE. FOR EXAMPLE (SEE 'CARD INPUT' SECTION) IF ONLY LOAD AND TRANSFORMATION ANALYSES ARE TO BE PERFORMED THE CARD MAY BE PUNCHED AS FOLLOWS.

```
00000000 ... 44
12345678 ... 34
   1  -5   KLUE(I), I=1 AND I=5.
```

WHERE COLUMNS ONE THROUGH FORTY ARE USED FOR DATA AND COLUMNS FORTY ONE THROUGH SEVENTY TWO ARE USED FOR IDENTIFICATION.

II. SUMMARY OF CONTROL WORD OPTIONS AND ITEMS AFFECTED BY THEM

THE VARIABLE KLUE(I) REPRESENTS THE CARD INPUT DATA CONTROL WORD OPTIONS ASSOCIATED WITH SOP. IT IS ENTERED AS DATA IN ITEM 6.

KLUE(1) OPTION FOR PERFORMING LOAD ANALYSIS. AFFECTS ALL DATA IN AUTOMATED LOAD ANALYSIS MODULE (ALAM).

KLUE(2) OPTION FOR ENTERING STRENGTH ANALYSIS MODULE. AFFECTS ALL DATA IN AUTOMATED STRENGTH ANALYSIS MODULE (ASAM).

KLUE(3) OPTION FOR GENERATING THE STIFFNESS OR FLEXIBILITY MATRICES TO BE SAVED FOR CALCULATING VIBRATION MODES IN AUTOMATED VIBRATION ANALYSIS MODULE (AVAM).

KLUE(5) OPTION FOR PERFORMING TRANSFORMATION ANALYSIS. AFFECTS ALL DATA IN AUTOMATED TRANSFORMATION MODULE (ATAM).

KLUE(6) OPTION FOR PERFORMING STRUCTURAL OPTIMIZATION. AFFECTS THE VARIABLE MAXAN IN ASAM ITEM 5.

KLUE(8) OPTION FOR INCLUDING RESULTS IN A REPORT. DOES NOT AFFECT ANY INPUT DATA.

KLUE(9) OPTION FOR LISTING AT END OF CALCULATIONS LABELS OF FILES GENERATED BY DSIO AND FSIO (DISK AND FORTRAN SEQUENTIAL INPUT/OUTPUT). DOES NOT AFFECT ANY INPUT DATA.

KLUE(10) OPTION FOR LISTING MESSAGES WHEN ENTERING AND LEAVING SUBROUTINES. DOES NOT AFFECT ANY INPUT DATA.

KLUE(11) OPTION FOR LISTING MAIN HEADING ENTERED FROM CARD DATA. DOES NOT AFFECT ANY INPUT DATA.

KLUE(12) OPTION FOR LISTING SUBHEADING ENTERED FROM CARD DATA. DOES NOT AFFECT ANY INPUT DATA.

KLUE(13) OPTION FOR LISTING INTERMEDIATE LABEL INFORMATION. DOES NOT AFFECT ANY INPUT DATA.

KLUE(14) OPTION FOR LISTING COMPUTER TIMES AT INTERVALS DURING PROGRAM EXECUTION. DOES NOT AFFECT ANY INPUT DATA.

KLUE(26) OPTION FOR DEFINING EITHER A CANTILEVER OR FREE-FREE SURFACE VIBRATION ANALYSIS. AFFECTS KLUES(19) TO KLUES(25) IN ITEM 3 OF ASAM AND ITEM 40 ALSO, IN ASAM. IT ALSO AFFECTS KLUE(37) IN FOP (PART C OF THIS VOLUME)

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*****************************************************************
*                                                               *
*     III.  PREPARATION OF CARD DATA                            *
*     ------------------------------                            *
*                                                               *
*       CARD INPUT DATA MUST ALWAYS BE ENTERED FOR THE MAIN     *
*     PROGRAM. REMAINING DATA WILL DEPEND UPON THE OPTIONS THE  *
*     USER IS EXERCISING.                                       *
*                                                               *
*****************************************************************
*                                                               *
*   1. ... SOP              IDENTIFIES THE BEGINNING OF THE     *
*      .                    CARD INPUT DATA TO THE STRUCTURAL   *
*      .                    OPTIMIZATION PACKAGE (SOP).         *
*      .                    USED WITHIN THE PROGRAM TO GENERATE *
*      .                    THE PERTINENT TITLE AND REFERENCE   *
*      .                    PAGE NUMBER APPEARING IN THE TABLE  *
*      .                    OF CONTENTS AT THE END OF EACH RUN. *
*      .                     MUST BE ENTERED AS SHOWN.          *
*      .                                                        *
*      .   LINESI           LINES PER INCH USED BY THE CURRENT  *
*      .                    PRINTERS FOR LISTING RESULTS.  A    *
*      .                    VALUE OF SIX SHOULD BE ENTERED WHEN *
*      .                    THE PRINTER UTILIZES EITHER AN      *
*      .                    ELEVEN BY FIFTEEN INCH PAPER WITH   *
*      .                    SIX LINES PER INCH DENSITY OR AN    *
*      .                    EIGHT AND ONE HALF BY FIFTEEN INCH  *
*      .                    PAPER WITH EIGHT LINES PER INCH     *
*      .                    DENSITY.  A VALUE OF EIGHT SHOULD   *
*      .                    BE ENTERED WHEN THE PRINTER         *
*      .                    UTILIZES AN ELEVEN BY FIFTEEN INCH  *
*      .                    PAPER WITH EIGHT LINES PER INCH     *
*      .                    DENSITY.  A DEFAULT VALUE OF SIX IS *
*      .                    PROVIDED IN SUBROUTINE LDB WHENEVER *
*      .                    ANY OTHER VALUE IS PRESENT ON THE   *
*      ...                  CARD.                               *
*                                                               *
*      ------------------------                                 *
*      000000000111111111122222|                                *
*      123456789012345678901234|                                *
*     |---|---|----------------|                                *
*     |SOP|   |  PACAGE, LINESI|                                *
*     |---|---|----------------|                                *
*                                                               *
*      FORMAT = (1A4, 1I4).  NUMBER OF CARDS IS 1.              *
*                                                               *
*      THE VARIABLE SOP IS ENTERED BY SUBROUTINE SOP AND        *
*      SUBROUTINE LDB WHERE IT IS PASSED TO SUBROUTINE DTABLE   *
*      TO GENERATE THE PROPER HEADING FOR THE TABLE OF          *
*      CONTENTS.  THE VARIABLE LINESI IS ENTERED BY SUBROUTINE  *
*      SOP AND SUBROUTINE LDB WHERE IT IS COMPARED AGAINST THE  *
*      STANDARD VALUES OF SIX AND EIGHT AND USES EITHER ONE OF  *
```

```
*     THEM OR THE DEFAULT VALUE CF SIX IF THE WRONG VALUE HAS     *
*     BEEN PUNCHED ON THE CARD.                                   *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*     REPEAT THE FOLLOWING ITEM FOR I =1,2, AND                   *
*     ENTER (EIGHTEEN WORDS PER CARD) FOR L=1,....,18.            *
*                                                                 *
*  2. ... TMH(L,I)        MAIN TITLE CONSISTING OF TWO CARDS.     *
*     .                   WILL BE LISTED AT THE TOP OF EACH       *
*     ...                 PAGE OF THE LISTED RESULTS.             *
*                                                                 *
*     FORMAT = (18A4).  NUMBER OF CARDS IS 2.                     *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE SOP.                         *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*     IN ADDITION TO THE ABOVE TITLE ADDITIONAL DESCRIPTIVE       *
*     INFORMATION MAY BE INCLUDED TO DESCRIBE THE CASE IN MORE    *
*     DETAIL.  THIS INFORMATION WILL APPEAR ONLY ONCE, IN THE     *
*     LISTING OF THE INPUT DATA AND MAY BE ENTERED OR DELETED     *
*     DEPENDING UPON THE CONTROL WORD OPTION ENTERED BY THE       *
*     FOLLOWING ITEM.                                             *
*                                                                 *
*                                                                 *
*  3. ... KTITLE = 0      DO NOT ENTER ADDITIONAL INFORMATION     *
*     .                   DESCRIBING THE CASE.                    *
*     .                                                           *
*     .          >= 1     ENTER KTITLE ADDITIONAL CARDS           *
*     ...                 DESCRIBING THE CASE.                    *
*                                                                 *
*     FORMAT = (1I4).  NUMBER OF CARDS IS 1.                      *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE SOP.                         *
*                                                                 *
*******************************************************************
*                                                                 *
*  4. ... LOGIC ITEM          *** NO DATA ***                     *
*     .                                                           *
*     .                   IF ADDITIONAL INFORMATION IS TO BE      *
*     .                   ENTERED (KTITLE LARGER THAN ZERO)       *
*     .                   ENTER THE FOLLOWING ITEM, OTHERWISE     *
*     ...                 (KTITLE = 0) OMIT THIS ITEM.            *
*                                                                 *
*******************************************************************
*                                                                 *
*     REPEAT THE FOLLOWING ITEM FOR K = 1,...., KTITLE.           *
*                                                                 *
*  5. ... TITLE           ADDITIONAL INFORMATION DESCRIBING       *
```

```
*      ...                  THE CASE.                                          *
*                                                                              *
*     FORMAT = (18A4).  NUMBER OF CARDS IS KTITLE.                             *
*                                                                              *
*     DATA ARE ENTERED BY SUBROUTINE SOP.                                      *
*                                                                              *
********************************************************************************
*                                                                              *
*                                                                              *
*        ALL CLUE VALUES INCLUDING ZEROS MAY BE ENTERED IF THE                 *
*     USER SO DESIRES.  IF THIS APPROACH IS TAKEN A CARD                       *
*     CONTAINING ONLY ZEROES SHOULD NOT BE INCLUDED AS DATA.                   *
*      IF THE USER WISHES TO MINIMIZE THE AMOUNT OF DATA, HE                   *
*     MAY ENTER ONLY NON-ZERO CLUE VALUES ACCORDING TO THE                     *
*     PROCEDURE DISCUSSED IN 'CONTROL WORD OPTION' SECTION.                    *
*      REGARDLESS OF WHICH APPROACH IS TAKEN THE LAST NON-ZERO                 *
*     VALUE ON THE LAST CARD MUST BE PRECEDED BY A NEGATIVE                    *
*     SIGN.                                                                    *
*                                                                              *
*  6. ... KLUE( 1) =  0  DO NOT ENTER LOAD ANALYSIS MODULE.                    *
*     .            =  1  ENTER LOAD ANALYSIS MODULE.                           *
*     .                                                                        *
*     .   KLUE( 2) =  0  DO NOT ENTER STRENGTH ANALYSIS                        *
*     .                  MODULE.                                               *
*     .            =  2  ENTER STRENGTH ANALYSIS MODULE.                       *
*     .                                                                        *
*     .   KLUE( 3) =  0  IF KLUE(2) = 2, STIFFNESS MATRIX                      *
*     .                  WILL BE CALCULATED FOR VIBRATION                      *
*     .                  MODE ANALYSIS.                                        *
*     .            =  3  IF KLUE(2) = 2, FLEXIBILITY MATRIX                    *
*     .                  WILL BE CALCULATED FOR VIBRATION                      *
*     .                  MODE ANALYSIS.                                        *
*     .                                                                        *
*     .                  NOTE IF KLUE(2) = 0, NEITHER THE                      *
*     .                  STIFFNESS NOR FLEXIBILITY MATRIX                      *
*     .                  CAN BE OBTAINED.  HOWEVER IF                          *
*     .                  KLUE(2) = 0, THE PROGRAM REQUIRES                     *
*     .                  THAT KLUE(3) = 0.                                     *
*     .                                                                        *
*     .   KLUE( 4) =  0  DUMMY VARIABLE.                                       *
*     .                                                                        *
*     .   KLUE( 5) =  0  DO NOT PERFORM TRANSFORMATION                         *
*     .                  ANALYSIS.                                             *
*     .            =  5  PERFORM TRANSFORMATION ANALYSIS.                      *
*     .                  REQUIRED IF KLUE(1) = 1 OR IF                         *
*     .                  KLUE(3) = 3.                                          *
*     .                                                                        *
*     .   KLUE( 6) =  0  DO NOT PERFORM STRENGTH                               *
*     .                  OPTIMIZATION.                                         *
*     .            =  6  PERFORM STRENGTH OPTIMIZATION.                        *
*     .                                                                        *
*     .   KLUE( 7) =  0  DUMMY VARIABLE.                                       *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*    .    KLUE( 8) =  0   RESULTS ARE NOT TO BE INCLUDED IN A      *
*    .                    REPORT.                                  *
*    .             =  8   RESULTS ARE TO BE INCLUDED IN A          *
*    .                    REPORT.                                  *
*    .                    THE RESULTS ARE LISTED IN A FORMAT       *
*    .                    SUITABLE FOR A REPORT. THAT IS. AN       *
*    .                    EIGHT AND ONE HALF BY ELEVEN PAPER.      *
*    .                                                             *
*    .    KLUE( 9) =  0   DO NOT LIST LABELS OF FILES              *
*    .                    GENERATED BY DSIO AND FSIO (DISK         *
*    .                    AND FORTRAN SEQUENTIAL                   *
*    .                    INPUT/OUTPUT).                           *
*    .             =  9   LIST LABELS OF FILES GENERATED BY        *
*    .                    DSIO AND FSIO (DISK AND FORTRAN          *
*    .                    SEQUENTIAL INPUT/OUTPUT). PROVIDES       *
*    .                    A RECORD OF PERMANENT FILES THAT         *
*    .                    ARE BEING SAVED AT THE END OF THIS       *
*    .                    RUN.                                     *
*    .                                                             *
*    .    KLUE(10) =  0   DO NOT LIST MESSAGES UPON ENTERING       *
*    .                    AND LEAVING SUBROUTINES.                 *
*    .             = 10   LIST MESSAGES UPON ENTERING AND          *
*    .                    LEAVING SUBROUTINES.                     *
*    .                                                             *
*    .    KLUE(11) =  0   DO NOT LIST MAIN HEADING.                *
*    .             = 11   LIST MAIN HEADING ENTERED AS CARD        *
*    .                    DATA AND CONSISTING OF TWO CARDS.        *
*    .                                                             *
*    .    KLUE(12) =  0   DO NOT LIST SUBHEADING IN EACH           *
*    .                    ANALYSIS MODULE.                         *
*    .             = 12   LIST SUBHEADING ENTERED AS CARD          *
*    .                    DATA AND CONSISTING OF ONE CARD.         *
*    .                                                             *
*    .    KLUE(13) =  0   DO NOT LIST INTERMEDIATE LABEL           *
*    .                    INFORMATION.                             *
*    .             = 13   LIST INTERMEDIATE LABEL                  *
*    .                    INFORMATION.  REQUIRED FOR               *
*    .                    DEBUGGING ONLY.                          *
*    .                                                             *
*    .    KLUE(14) =  0   DO NOT LIST COMPUTER TIMES.              *
*    .             = 14   LIST COMPUTER TIMES AT INTERVALS         *
*    .                    DURING PROGRAM EXECUTION.                *
*    .                                                             *
*    .    KLUE(15) =  0   DUMMY OPTION.                            *
*    .                                                             *
*    .    KLUE(16) =  0   DUMMY OPTION.                            *
*    .                                                             *
*    .    KLUE(17) =  0   DUMMY OPTION.                            *
*    .                                                             *
*    .    KLUE(18) =  0   DUMMY OPTION.                            *
*    .                                                             *
*    .    KLUE(19) =  0   DUMMY OPTION.                            *
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

*      .    KLUE(20) =   0  DUMMY CPTION.                             *
*      .                                                              *
*      .    KLUE(21) =   0  DUMMY CPTION.                             *
*      .                                                              *
*      .    KLUE(22) =   0  DUMMY CPTION.                             *
*      .                                                              *
*      .    KLUE(23) =   0  DUMMY CPTION.                             *
*      .                                                              *
*      .    KLUE(24) =   0  DUMMY OPTION.                             *
*      .                                                              *
*      .    KLUE(25) =   0  DUMMY CPTION.                             *
*      .                                                              *
*      .    KLUE(26) =   0  CANTILEVER WING VIBRATION ANALYSIS        *
*      .                    TO BE PERFORMED IN FOP (AVAM).            *
*      .                                                              *
*      .             = 26   FREE FREE WING VIBRATION ANALYSIS         *
*      ...                  TO BE PERFORMED IN FOP (AVAM).            *
*                                                                     *
*      FORMAT = (10I4).  NUMBER OF CARDS IS 3 OR LESS DEPENDING       *
*      ON THE NUMBER CF CCNTRCL CPTIONS ENTERED AS DATA.              *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE SOP THROUGH THE                 *
*      SUBROUTINE CLUES.                                              *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*      THE FCLLOWING ITEM PROVIDES THE PROGRAM WITH THE FILE          *
*      NUMBERS OF DATA SAVED FROM A PREVIOUS RUN ON MULTI-FILE        *
*      UNIT 17 AND REQUIRED FOR EXECUTION OF THE CURRENT RUN.         *
*       TO OBTAIN THIS INFORMATION THE USER WILL REFER TO A           *
*      SUMMARY TABLE AT THE END OF THE RUN IN WHICH THE               *
*      REQUIRED FILES WERE GENERATED.  THIS TABLE INDICATES THE       *
*      FILE NUMBER OF EACH DATA SET THAT HAS BEEN SAVED. NOTE         *
*      THAT FCR THE FIRST RUN, THIS DATA ITEM WILL BE SET TO          *
*      ZERO. (TWO BLANK CARDS).                                       *
*                                                                     *
*                                                                     *
*      USE APPROPRIATE VALUE FOR THE FILE NUMBER IF INFORMATION       *
*      HAS BEEN GENERATED AND STORED ON UNIT 17.  OTHERWISE           *
*      ENTER ZERO FOR THE FILE NUMBER.                                *
*                                                                     *
*   7. ... JFILES( 1)       FILE NUMBER FOR RETRIEVING GENERAL        *
*      .                    TYPE INFORMATION (GEOMETRY, PANEL         *
*      .                    AREAS) FOR SUBSONIC FLOW ANALYSIS.        *
*      .                     DATA NAME IS JGGE01.                     *
*      .                                                              *
*      .   JFILES( 2)       FILE NUMBER FOR RETRIEVING THE            *
*      .                    AERODYNAMIC GRID GEOMETRY FOR             *
*      .                    SUBSCNIC FLOW ANALYSIS.  DATA NAME        *
*      .                    IS JAGEC1.                                *
```

```
 ITEM        DATA               DESCRIPTION
 ----        ----               -----------

*       .    JFILES( 3)         FIRST FILE NUMBER OF A GROUP OF              *
*       .                       FILES FOR RETRIEVING THE                     *
*       .                       RIGID-SURFACE SYMMETRIC AND/OR               *
*       .                       ANTISYMMETRIC AERODYNAMIC INFLUENCE          *
*       .                       COEFFICIENT MATRICES (AERODYNAMICS           *
*       .                       GRID) FOR A NUMBER OF MACH NUMBERS           *
*       .                       AND UNIT PRESSURES AND FOR SUBSONIC          *
*       .                       FLOW ANALYSIS.  DATA NAME IS                 *
*       .                       JARAI1.                                      *
*       .                                                                    *
*       .    JFILES( 4)         DUMMY FILE.                                  *
*       .                                                                    *
*       .    JFILES( 5)         FILE NUMBER FOR RETRIEVING GENERAL           *
*       .                       TYPE INFORMATION (GEOMETRY, PANEL            *
*       .                       AREAS) FOR SUPERSONIC FLOW                   *
*       .                       ANALYSIS.  DATA NAME IS JGGEO2.              *
*       .                                                                    *
*       .    JFILES( 6)         FILE NUMBER FOR RETRIEVING THE               *
*       .                       AERODYNAMIC GRID GEOMETRY FOR                *
*       .                       SUPERSONIC FLOW ANALYSIS.  DATA              *
*       .                       NAME IS JAGEO2.                              *
*       .                                                                    *
*       .    JFILES( 7)         FIRST FILE NUMBER OF A GROUP OF              *
*       .                       FILES FOR RETRIEVING THE                     *
*       .                       RIGID-SURFACE SYMMETRIC AND/OR               *
*       .                       ANTISYMMETRIC AERODYNAMIC INFLUENCE          *
*       .                       COEFFICIENT MATRICES (AERODYNAMICS           *
*       .                       GRID) FOR A NUMBER OF MACH NUMBERS           *
*       .                       AND UNIT PRESSURES AND FOR                   *
*       .                       SUPERSONIC FLOW ANALYSIS.  DATA              *
*       .                       NAME IS JARAI2.                              *
*       .                                                                    *
*       .    JFILES( 8)         DUMMY FILE.                                  *
*       .                                                                    *
*       .    JFILES( 9)         DUMMY FILE.                                  *
*       .                                                                    *
*       .    JFILES(10)         FILE NUMBER FOR RETRIEVING THE               *
*       .                       TRANSFORMATION MATRIX FROM THE               *
*       .                       AERODYNAMICS TO THE STRUCTURES               *
*       .                       GRID.  DATA NAME IS JATRAN.                  *
*       .                                                                    *
*       .    JFILES(11)         FILE NUMBER FOR RETRIEVING PANEL             *
*       .                       AERODYNAMIC LOADS IN THE STRUCTURES          *
*       .                       GRID.  DATA NAME IS JSAPL.                   *
*       .                                                                    *
*       .    JFILES(12)         FILE NUMBER FOR RETRIEVING THE               *
*       .                       WEIGHTS GRID GEOMETRY.  DATA NAME            *
*       .                       IS JWGEOM.                                   *
*       .                                                                    *
*       .    JFILES(13)         FILE NUMBER FOR RETRIEVING THE               *
*       .                       TRANSFORMATION MATRIX FROM THE               *
*       .                       WEIGHTS TO THE STRUCTURES GRID.              *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*    .                        DATA NAME IS JWTRAN.                      *
*    .                                                                  *
*    .    JFILES(14)         FILE NUMBER FOR RETRIEVING PANEL           *
*    .                       INERTIAL LOADS IN THE STRUCTURES           *
*    .                       GRID.  DATA NAME IS JSIPL.                 *
*    .                                                                  *
*    .    JFILES(15)         FILE NUMBER FOR RETRIEVING TOTAL           *
*    .                       PANEL LOADS IN THE STRUCTURES GRID.        *
*    .                        DATA NAME IS JSTPL.                       *
*    .                                                                  *
*    .    JFILES(16)         FILE NUMBER FOR RETRIEVING THE             *
*    .                       DYNAMICS GRID GEOMETRY.  DATA NAME         *
*    .                       IS JDGECM.                                 *
*    .                                                                  *
*    .    JFILES(17)         FILE NUMBER FOR RETRIEVING THE             *
*    .                       TRANSFORMATION MATRIX FROM THE             *
*    .                       DYNAMICS TO THE STRUCTURES GRID.           *
*    .                        DATA NAME IS JDTRAN.                      *
*    .                                                                  *
*    .    JFILES(18)         DUMMY FILE.                                *
*    .                                                                  *
*    .    JFILES(19)         LAST FILE NUMBER ON THE INPUT TAPE         *
*    .                       INDICATING TOTAL NUMBER OF FILES.          *
*    ...                      DATA NAME IS JLDATA.                      *
*                                                                       *
*    FORMAT = (10I4).  NUMBER OF CARDS IS 2.                            *
*                                                                       *
*    DATA ARE ENTERED BY SUBROUTINE SOP.                                *
*                                                                       *
*************************************************************************
```

ITEM DATA DESCRIPTION

ALAM - AUTOMATED LOAD ANALYSIS MODULE

I. PREPARATION OF CARD DATA

CARD INPUT DATA MUST ALWAYS BE ENTERED FOR THE MAIN PROGRAM. REMAINING DATA WILL DEPEND UPON THE OPTIONS THE USER IS EXERCISING.

THE LOAD ANALYSIS PROGRAM IS SUBDIVIDED INTO A NUMBER OF GROUPS TO PERFORM PARTIAL OR COMPLETE LOAD ANALYSES. THE ANALYSES INCLUDE PANEL INERTIAL AND AERODYNAMIC LOADS (SUBSONIC OR SUPERSONIC) AND COMBINATION OF THE INERTIAL AND AERODYNAMIC LOADS TO PROVIDE A TOTAL PANEL DISTRIBUTION.

ITEM	DATA	DESCRIPTION
1.	... LA00	IDENTIFIES THE BEGINNING OF THE CARD INPUT DATA TO THE AUTOMATED LOAD ANALYSIS MODULE (ALAM). MUST BE ENTERED AS SHOWN.

USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE AND REFERENCE PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT THE END OF EACH EXECUTION. REMAINING COLUMNS (FIVE TO SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION THE USER WISHES TO INCLUDE.

```
----------
0000000001
1234567890
----------
LA00|
```

FORMAT = (1A4). NUMBER OF CARDS IS 1.

DATA ARE ENTERED BY SUBROUTINE ALAM AND SUBROUTINE LDB WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE PROPER HEADING FOR THE TABLE OF CONTENTS.

ENTER (SIXTEEN WORDS PER CARD)

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     FOR THE FOLLOWING ITEM FOR L=1,....,16.                        *
*                                                                    *
*  2. ... TSHL(L)          SUBTITLE CONSISTING OF ONE CARD.          *
*                                                                    *
*     WILL BE LISTED AFTER THE MAIN TITLE AT THE TOP OF EACH         *
*     PAGE OF THE LISTED RESULTS AND WILL BE USED TO DEFINE          *
*     THE TYPE OF LOAD ANALYSIS BEING PERFORMED.  THE SUBTITLE       *
*     IS INCREASED TO EIGHTEEN WORDS WITHIN THE PROGRAMS WHERE       *
*     THE LAST TWO WORDS ARE USED TO IDENTIFY THE PROGRAM FROM       *
*     WHICH RESULTS ARE LISTED.                                      *
*                                                                    *
*     FORMAT = (16A4).  NUMBER OF CARDS IS 1.                        *
*                                                                    *
*     DATA ARE ENTERED BY THE SUBROUTINE ALAM.                       *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*        ALL CLUE VALUES INCLUDING ZEROS MAY BE ENTERED IF THE       *
*     USER SO DESIRES.  IF THIS APPROACH IS TAKEN A CARD             *
*     CONTAINING ONLY ZEROES SHOULD NOT BE INCLUDED AS DATA.         *
*     IF THE USER WISHES TO MINIMIZE THE AMOUNT OF DATA, HE          *
*     MAY ENTER ONLY NON-ZERO CLUE VALUES ACCORDING TO THE           *
*     PROCEDURE DISCUSSED IN 'CONTROL WORD OPTION' SECTION.          *
*     REGARDLESS OF WHICH APPROACH IS TAKEN THE LAST NON-ZERO        *
*     VALUE ON THE LAST CARD MUST BE PRECEDED BY A NEGATIVE          *
*     SIGN.                                                          *
*                                                                    *
*  3. ... KLUEL( 1) =  0 DO NOT PERFORM SUBSONIC FLOW                *
*     .                  ANALYSIS.                                   *
*     .             =  1 PERFORM SUBSONIC FLOW ANALYSIS.             *
*     .                                                              *
*     .   KLUEL( 2) =  0 DO NOT PERFORM SUPERSONIC FLOW              *
*     .                  ANALYSIS.                                   *
*     .             =  2 PERFORM SUPERSONIC FLOW ANALYSIS.           *
*     .                                                              *
*     .   KLUEL( 3) =  0 FIXED VARIABLE, EQUAL TO ZERO.              *
*     .                                                              *
*     .   KLUEL( 4) =  0 DO NOT CALCULATE AERODYNAMIC LOADS          *
*     .                  IN AERODYNAMICS GRID.                       *
*     .             =  4 CALCULATE AERODYNAMIC LOADS IN              *
*     .                  AERODYNAMICS GRID.                          *
*     .                                                              *
*     .   KLUEL( 5) =  0 INCLUDE DISTRIBUTED MASS PROPERTIES         *
*     .                  ONLY.                                       *
*     .             =  5 INCLUDE DISTRIBUTED AND                     *
*     .                  CONCENTRATED MASS PROPERTIES.               *
*     .                                                              *
*     .   KLUEL( 6) =  0 DO NOT PUNCH ON CARDS THE GEOMETRY          *
*     .                  DESCRIBING THE AERODYNAMIC SURFACE.         *
*     .             =  6 PUNCH ON CARDS THE GEOMETRY                 *
*     .                  DESCRIBING THE AERODYNAMIC SURFACE.         *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     .   KLUEL( 7) =   0 FIXED VARIABLE, EQUAL TO ZERO.              *
*     .                                                               *
*     .   KLUEL( 8) =   0 FIXED VARIABLE, EQUAL TO ZERO.              *
*     .                                                               *
*     .   KLUEL( 9) =   0 DO NOT INCLUDE CAMBER ANGLES.               *
*     .             =   9 INCLUDE CAMBER ANGLES.                      *
*     .                                                               *
*     .   KLUEL(10) =   0 THERE WILL BE NO SCALAR (EMPIRICAL)         *
*     .                   CORRECTION FACTORS TO THE SPECIFIED         *
*     .                   WING AND CONTROL SURFACE ANGLE OF           *
*     .                   ATTACK DISTRIBUTION (CORRECTION             *
*     .                   FACTOR = 1.0) AND THERE WILL BE NO          *
*     .                   ADDITIVE ANGLE OF ATTACK                    *
*     .                   CORRECTIONS TO THESE DISTRIBUTIONS.         *
*     .             =  10 SOME OR ALL OF THE CORRECTION               *
*     .                   FACTORS WILL BE SUPPLIED BY THE             *
*     .                   USER.                                       *
*     .                                                               *
*     .   KLUEL(11) =   0 CALCULATE THE Z FORCE COMPONENTS            *
*     .                   FOR DISTRIBUTED MASSES AND Z FORCE          *
*     .                   AND Y MOMENT COMPONENTS FOR                 *
*     .                   CONCENTRATED MASSES IF INCLUDED             *
*     .                   (KLUEL(5) = 5) IN THE WEIGHTS GRID.         *
*     .             =  11 CALCULATE THE X, Y, Z FORCE                 *
*     .                   COMPONENTS FOR DISTRIBUTED MASSES           *
*     .                   AND X, Y, Z FORCE AND MOMENT                *
*     .                   COMPONENTS FOR CONCENTRATED MASSES          *
*     .                   IF INCLUDED (KLUEL(5) = 5) IN THE           *
*     .                   WEIGHTS GRID.                               *
*     .                                                               *
*     .   KLUEL(12) =   0 DO NOT CALCULATE INERTIAL LOADS IN          *
*     .                   THE WEIGHTS GRID.                           *
*     .             =  12 CALCULATE INERTIAL LOADS IN THE             *
*     .                   WEIGHTS GRID.                               *
*     .                                                               *
*     .   KLUEL(13) =   0 FIXED VARIABLE, EQUAL TO ZERO.              *
*     .                                                               *
*     .   KLUEL(14) =   0 DO NOT CALCULATE NOR STORE ON UNIT          *
*     .                   17 THE SYMMETRIC RIGID-SURFACE              *
*     .                   AERODYNAMIC - INFLUENCE -                   *
*     .                   COEFFICIENT MATRIX FOR EACH MACH            *
*     .                   NUMBER AND UNIT DYNAMIC PRESSURE.           *
*     .             =  14 CALCULATE AND STORE ON UNIT 17 THE          *
*     .                   SYMMETRIC RIGID-SURFACE AERODYNAMIC         *
*     .                   - INFLUENCE - COEFFICIENT MATRIX            *
*     .                   FOR EACH MACH NUMBER AND UNIT               *
*     .                   DYNAMIC PRESSURE.                           *
*     .                                                               *
*     .   KLUEL(15) =   0 DO NOT CALCULATE NOR STORE ON UNIT          *
*     .                   17 THE ANTISYMMETRIC RIGID-SURFACE          *
*     .                   AERODYNAMIC - INFLUENCE -                   *
*     .                   COEFFICIENT MATRIX FOR EACH MACH            *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*      .                     NUMBER AND UNIT DYNAMIC PRESSURE.        *
*      .              = 15 CALCULATE AND STORE ON UNIT 17 THE         *
*      .                     ANTISYMMETRIC RIGID-SURFACE               *
*      .                     AERODYNAMIC - INFLUENCE -                 *
*      .                     COEFFICIENT MATRIX FOR EACH MACH          *
*      .                     NUMBER AND UNIT DYNAMIC PRESSURE.         *
*      .                                                               *
*      .   KLUEL(16) =  0 FIXED VARIABLE. EQUAL TO ZERO.               *
*      .                                                               *
*      .   KLUEL(17) =  0 AT THE TIME OF CALCULATION DO NOT            *
*      .                  LIST SYMMETRIC AND/OR ANTISYMMETRIC          *
*      .                  RIGID-SURFACE AERODYNAMIC INFLUENCE          *
*      .                  COEFFICIENT MATRICES.                        *
*      .             = 17 AT THE TIME OF CALCULATION LIST              *
*      .                  SYMMETRIC AND/OR ANTISYMMETRIC               *
*      .                  RIGID-SURFACE AERODYNAMIC INFLUENCE          *
*      .                  COEFFICIENT MATRICES.                        *
*      .                                                               *
*      .   KLUEL(18) =  0 FIXED VARIABLE, EQUAL TO ZERO.               *
*      .                                                               *
*      .   KLUEL(19) = 19 FIXED VARIABLE.                              *
*      .                                                               *
*      .   KLUEL(20) =  0 DO NOT CALCULATE INERTIAL LOADS IN           *
*      .                  THE STRUCTURES GRID. KLUEL(20) = 0           *
*      .                  IF KLUEL(12) = 0.                            *
*      .             = 20 CALCULATE THE INERTIAL LOADS IN THE          *
*      .                  STRUCTURES GRID.                             *
*      .                                                               *
*      .   KLUEL(21) =  0 DO NOT CALCULATE AERODYNAMIC LOADS           *
*      .                  IN THE STRUCTURES GRID. KLUEL(21) =          *
*      .                  0 IF KLUEL(4) = 0.                           *
*      .             = 21 CALCULATE AERODYNAMIC LOADS IN THE           *
*      .                  STRUCTURES GRID.                             *
*      .                                                               *
*      .   KLUEL(22) =  0 DO NOT CALCULATE TOTAL LOADS IN THE          *
*      .                  STRUCTURES GRID.                             *
*      .             = 22 CALCULATE TOTAL LOADS IN THE                 *
*      ...                STRUCTURES GRID.                             *
*                                                                      *
*      FORMAT = (10I4).  NUMBER OF CARDS IS 3 OR LESS DEPENDING        *
*      UPON THE CONTROL WORD OPTIONS ENTERED AS DATA.                  *
*                                                                      *
*      DATA ARE ENTERED BY THE SUBROUTINE ALAM THROUGH THE             *
*      SUBROUTINE CLUES.                                               *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*      A.  AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC FLOW        *
*      ---------------------------------------------------------       *
*                                                                      *
************************************************************************
```

```
ITEM     DATA              DESCRIPTION
----     ----              -----------

*  4. ... LOGIC ITEM          *** NO DATA ***                          *
*                                                                      *
*                                                                      *
*     IF SUBSONIC FLOW ANALYSIS IS TO BE PERFORMED (KLUEL(1) =         *
*     1), ENTER THE FOLLOWING SEVEN ITEMS, OTHERWISE                   *
*     (KLUEL(1) = 0)  OMIT THESE ITEMS.                                *
*                                                                      *
*     IF IN ADDITION TO SUBSONIC FLOW A SUPERSONIC FLOW                *
*     ANALYSIS IS TO BE PERFORMED (KLUEL(2) = 2), THE SURFACE          *
*     GEOMETRY MUST BE IDENTICAL FOR BOTH AERODYNAMIC MODELS.          *
*                                                                      *
************************************************************************
*                                                                      *
*  5. ... LA01                IDENTIFIES THE BEGINNING OF THE          *
*     .                       CARD INPUT DATA TO THE AERODYNAMIC       *
*     .                       INFLUENCE COEFFICIENTS FOR SUBSONIC      *
*     .                       FLOW SUBMODULE, IN THE AUTOMATED         *
*     .                       LOAD ANALYSIS MODULE (ALAM). MUST        *
*     ...                     BE ENTERED AS SHOWN.                     *
*                                                                      *
*     USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE          *
*     AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT            *
*     THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO           *
*     SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION         *
*     THE USER WISHES TO INCLUDE.                                      *
*                                                                      *
*                                                                      *
*     ----------                                                       *
*     0000000001                                                       *
*     1234567890                                                       *
*     ----------                                                       *
*     LA01|     |                                                      *
*     ----------                                                       *
*                                                                      *
*     FORMAT = (1A4).  NUMBER OF CARDS IS 1.                           *
*                                                                      *
*     DATA ARE ENTERED BY SUBROUTINE L1 AND SUBROUTINE LDB             *
*     WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE          *
*     PROPER HEADING FOR THE TABLE OF CONTENTS.                        *
*                                                                      *
************************************************************************
*                                                                      *
*  6. ... NUMAN ≤ 8           NUMBER OF MACH NUMBERS.                  *
*     .                                                                *
*     .   NSA ≤ 6             NUMBER OF SPANWISE AREAS ON THE          *
*     .                       SURFACE.                                 *
*     .       ≤ 2             IF SUPERSONIC FLOW ANALYSIS              *
*     .                       (KLUEL(2) = 2) IS ALSO TO BE             *
*     .                       PERFORMED.                               *
*     .                                                                *
*     .   ITOT ≤ 150          NUMBER OF PANELS ON THE SURFACE.         *
*     .        ≤ 100          IF SUPERSONIC FLOW ANALYSIS              *
*     .                       (KLUEL(2) = 2) IS ALSO TO BE             *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     ...                    PERFORMED.                                   *
*                                                                         *
*     SEE FIGURE 1B.                                                      *
*                                                                         *
*     FORMAT = (3I4).  NUMBER OF CARDS IS 1.                              *
*                                                                         *
*     DATA ARE ENTERED BY SUBROUTINE L1.                                  *
*                                                                         *
***************************************************************************
*                                                                         *
*  7. ... R                  RADIUS OF FUSELAGE, IN.                R     *
*      .                     IF THE FUSELAGE IS NOT TO BE                 *
*      .                     INCLUDED, LET R = 0.001. WHEN                *
*      .                     SUPERSONIC LOADS ARE ALSO TO BE              *
*      .                     INCLUDED THEN R = 0.001.                     *
*      .                                                                  *
*     ... S                  SEMISPAN, IN.                          S     *
*                                                                         *
*     SEE FIGURE 1A.                                                      *
*                                                                         *
*     FORMAT = (2E12.4).  NUMBER OF CARDS IS 1.                           *
*                                                                         *
*     DATA ARE ENTERED BY SUBROUTINE L1.                                  *
*                                                                         *
***************************************************************************
*                                                                         *
*                                                                         *
*     ENTER (FOUR VALUES OR LESS PER CARD) AND                            *
*     REPEAT THE FOLLOWING ITEM FOR I=1,...,NUMAN.                        *
*                                                                         *
*  8. ... AMACH(I)           MACH NUMBER.                           Mi    *
*                                                                         *
*     FORMAT = (4E12.4).  NUMBER OF CARDS IS (NUMAN-1)/4 +1.              *
*                                                                         *
*     DATA ARE ENTERED BY SUBROUTINE L1.                                  *
*                                                                         *
***************************************************************************
*                                                                         *
*                                                                         *
*     REPEAT THE FOLLOWING ITEM FOR I= 1,....NSA.                         *
*                                                                         *
*  9. ... OMEG(I)            LEADING EDGE SWEEP ANGLE FOR THE       θI    *
*      .                     I'TH SPANWISE AREA, STARTING                 *
*      .                     INBOARD, DEG.                                *
*      .                                                                  *
*      .  DYI(I)             WIDTH FOR THE I'TH SPANWISE AREA       ΔYI   *
*      .                     STARTING INBOARD, IN.                        *
*      .                                                                  *
*      .  AD(I)              CHORDWISE LEADING EDGE                 AI    *
*      .                     DISCONTINUITY FOR THE I'TH SPANWISE          *
*      .                     AREA, IN. PLUS IF THE LEADING EDGE           *
*      .                     OF AN OUTBOARD AREA IS AFT OF THE            *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*      .                    ADJACENT INBOARD AREA. MUST BE ZERO       *
*      .                    IF KLUEL(2) = 2.                          *
*      .                                                              *
*      .   AE(I)            CHORDWISE TRAILING EDGE               B_I *
*      .                    DISCONTINUITY FOR THE I'TH SPANWISE       *
*      .                    AREA, IN. POSITIVE IF THE TRAILING        *
*      .                    EDGE OF AN OUTBOARD AREA IS AFT OF        *
*      .                    THE ADJACENT INBOARD AREA. MUST BE        *
*      ...                  ZERO IF KLUEL(2) = 2.                     *
*                                                                     *
*      SEE FIGURE 1B.                                                 *
*                                                                     *
*      FORMAT = (4E12.4).  NUMBER OF CARDS IS NSA.                    *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE L1.                             *
*                                                                     *
***********************************************************************
*                                                                     *
*      THE CHORDWISE STRIPS, DEPENDENT ON VARIABLES PERCH1(I)         *
*      AND PERCH2(I), ARE DEFINED IN FIGURE 1D.  THESE TWO            *
*      LIMITS WILL PROVIDE A MAXIMUM OF THREE CHORDWISE STRIPS        *
*      WHERE THE AFT LIMIT OF THE THIRD CHORDWISE STRIP IS THE        *
*      SURFACE TRAILING EDGE.                                         *
*                                                                     *
*      THE SPANWISE STRIPS, DEPENDENT ON VARIABLE NSPNL(I), ARE       *
*      DEFINED IN FIGURE 1C.                                          *
*                                                                     *
*      THE CHORDWISE DIVISIONS, DEPENDENT ON VARIABLES                *
*      NCPL1(I), NCPL2(I), AND NCPL3(I), ARE DEFINED IN FIGURE        *
*      1E.                                                            *
*                                                                     *
*                                                                     *
*      REPEAT THE FOLLOWING ITEM FOR I= 1,....,NSA.                   *
*                                                                     *
*                                                                     *
* 10.  ... PERCH1(I)        AFT LIMIT OF THE FIRST CHORDWISE          *
*      .                    STRIP IN THE I'TH SPANWISE AREA           *
*      .                    STARTING INBOARD. PERCENT CHORD.          *
*      .                                                              *
*      .   PERCH2(I)        AFT LIMIT OF THE SECOND CHORDWISE         *
*      .                    STRIP IN THE I'TH SPANWISE AREA,          *
*      .                    PERCENT CHORD.                            *
*      .                                                              *
*      .   NSPNL(I) ≤ 10    NUMBER OF SPANWISE STRIPS IN THE   N^SS_I *
*      .                    I'TH SPANWISE AREA.                       *
*      .                                                              *
*      .   NCPL1(I) ≤ 7     NUMBER OF CHORDWISE DIVISIONS IN  N^CP_1I *
*      .                    THE FIRST CHORDWISE STRIP AND THE         *
*      .                    I'TH SPANWISE AREA.                       *
*      .                                                              *
*      .   NCPL2(I) ≤ 7     NUMBER OF CHORDWISE DIVISIONS IN  N^CP_2I *
*      .                    THE SECOND CHORDWISE STRIP AND THE        *
```

```
 ITEM      DATA                DESCRIPTION
 ----      ----                -----------

*      .                      I'TH SPANWISE AREA.                          *
*      .                                                           N^CP   *
*      .   NCPL3(I) ≤ 7       NUMBER OF CHORDWISE DIVISIONS IN       3I   *
*      .                      THE THIRD CHORDWISE STRIP AND THE           *
*      ...                    I'TH SPANWISE AREA.                          *
*                                                                          *
*      THE CHORDWISE PANELS ARE NUMBERED STARTING FROM THE TIP            *
*      LEADING EDGE MOVING AFT. AS INDICATED, EACH CHORDWISE              *
*      STRIP MAY CONTAIN UP TO SEVEN PANELS BUT THE TOTAL                 *
*      NUMBER OF PANELS IN THE FORE-AFT DIRECTION MUST NOT                *
*      EXCEED SIXTEEN, THAT IS, NCPL1(I) + NCPL2(I) + NCPL3(I)            *
*      SHOULD BE EQUAL TO OR LESS THAN SIXTEEN.                           *
*      NOTEO  IF IN THE I'TH SPANWISE AREA THERE IS ONLY ONE              *
*      CHORDWISE STRIP WITH 6 CHORDWISE DIVISIONS AND 5                   *
*      SPANWISE STRIPS, THEN DATA WOULD BE                                *
*      100.0 100.0    5    6    0    0.                                   *
*                                                                          *
*      FORMAT = (2F6.2,4I4). NUMBER OF CARDS IS NSA.                      *
*                                                                          *
*      DATA ARE ENTERED BY SUBROUTINE L1.                                 *
*                                                                          *
****************************************************************************
*                                                                          *
*                                                                          *
*      ENTER (FOUR VALUES OR LESS PER CARD) AND                           *
*      REPEAT THE FOLLOWING ITEM FOR I = 1,....,NSA1 = NSA+1.             *
*                                                                          *
* 11. ... CORDI(I)            CHORD FOR I'TH SPANWISE AREA         C_I    *
*      .                      BEGINNING WITH INBOARD CHORD OF             *
*      .                      FIRST SPANWISE AREA AND ENDING WITH         *
*      .                      OUTBOARD CHORD OF LAST SPANWISE             *
*      ...                    AREA, IN.                                   *
*                                                                          *
*      SEE FIGURE 18.                                                     *
*                                                                          *
*      FORMAT = (4E12.4).  NUMBER OF CARDS IS (NSA1-1)/4 + 1.             *
*                                                                          *
*      DATA ARE ENTERED BY SUBROUTINE L1.                                 *
*                                                                          *
****************************************************************************
*                                                                          *
*                                                                          *
*      B.  AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUPERSONIC FLOW*
*      ---------------------------------------------------------*
*                                                                          *
****************************************************************************
*                                                                          *
* 12. ... LOGIC ITEM            *** NO DATA ***                           *
*                                                                          *
*                                                                          *
*      IF SUPERSONIC FLOW ANALYSIS IS TO BE PERFORMED (KLUEL(2)           *
*      = 2) ENTER FOLLOWING SEVEN ITEMS, OTHERWISE (KLUEL(2) =            *
```

```
 ITEM      DATA                DESCRIPTION
 ----      ----                -----------

*      0)  OMIT THESE ITEMS.                                           *
*                                                                      *
************************************************************************
*                                                                      *
* 13. ... LAC2                 IDENTIFIES THE BEGINNING OF THE         *
*      .                       CARD INPUT DATA TO THE AERODYNAMIC      *
*      .                       INFLUENCE COEFFICIENTS FOR              *
*      .                       SUPERSONIC FLOW SUBMODULE, IN THE       *
*      .                       AUTOMATED LOAD ANALYSIS MODULE          *
*     ...                      (ALAM). MUST BE ENTERED AS SHOWN.       *
*                                                                      *
*      USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE         *
*      AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT           *
*      THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO          *
*      SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION        *
*      THE USER WISHES TO INCLUDE.                                     *
*                                                                      *
*      -----------                                                     *
*     |0000000001|                                                     *
*     |1234567890|                                                     *
*     |----------|                                                     *
*     |LA02|     |                                                     *
*      -----------                                                     *
*                                                                      *
*      FORMAT = (1A4).  NUMBER OF CARDS IS 1.                          *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE L2 AND SUBROUTINE LDB            *
*      WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE         *
*      PROPER HEADING FOR THE TABLE OF CONTENTS.                       *
*                                                                      *
************************************************************************
*                                                                      *
* 14. ... NUMAN ≤ 8            NUMBER OF MACH NUMBERS.           N_M   *
*      .                                                               *
*      .   NSA ≤ 2             NUMBER OF SPANWISE AREAS ON THE   N_sa  *
*      .                       SURFACE.                                *
*      .                                                               *
*     ... ITOT ≤ 100           NUMBER OF PANELS ON THE SURFACE.  I_T   *
*                                                                      *
*      SEE FIGURE 18.                                                  *
*                                                                      *
*      FORMAT = (3I4).  NUMBER OF CARDS IS 1.                          *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE L2.                              *
*                                                                      *
************************************************************************
*                                                                      *
* 15. ... R                    RADIUS OF FUSELAGE, IN.            R    *
*      .                       FOR SUPERSONIC FLOW, R = 0.001.         *
*      .                                                               *
*     ... S                    SEMISPAN, IN.                      S    *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*      SEE FIGURE 1A.                                                  *
*                                                                      *
*      FORMAT = (2E12.4).  NUMBER OF CARDS IS 1.                       *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE L2.                              *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*      ENTER (FOUR VALUES OR LESS PER CARD) AND                        *
*      REPEAT THE FOLLOWING ITEM FOR I=1,....,NUMAN.                   *
*                                                                      *
* 16.  ... AMACH(I)          MACH NUMBER.                          Mi  *
*                                                                      *
*      FORMAT = (4E12.4).  NUMBER OF CARDS IS (NUMAN-1)/4 +1.          *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE L2.                              *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*      REPEAT THE FOLLOWING ITEM FOR I= 1,....,NSA.                    *
*                                                                      *
* 17.  ... OMEG(I)           LEADING EDGE SWEEP ANGLE FOR THE      θI  *
*      .                     I'TH SPANWISE AREA, STARTING              *
*      .                     INBOARD, DEG.                             *
*      .                                                               *
*      .    DYI(I)           WIDTH FOR THE I'TH SPANWISE AREA     ΔYI  *
*      .                     STARTING INBOARD, IN.                     *
*      .                                                               *
*      .    AD(I)            CHORDWISE LEADING EDGE                AI  *
*      .                     DISCONTINUITY FOR THE I'TH SPANWISE       *
*      .                     AREA, IN.                                 *
*      .                     MUST BE MADE EQUAL TO ZERO FOR            *
*      .                     SUPERSONIC FLOW.                          *
*      .                                                               *
*      .    AE(I)            CHORDWISE TRAILING EDGE               BI  *
*      .                     DISCONTINUITY FOR THE I'TH SPANWISE       *
*      .                     AREA, IN.                                 *
*      .                     MUST BE MADE EQUAL TO ZERO FOR            *
*      ...                   SUPERSONIC FLOW.                          *
*                                                                      *
*      SEE FIGURE 1B.                                                  *
*                                                                      *
*      FORMAT = (4E12.4).  NUMBER OF CARDS IS NSA.                     *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE L2.                              *
*                                                                      *
************************************************************************
*                                                                      *
*      THE CHORDWISE STRIPS, DEPENDENT ON VARIABLES PERCH1(I)          *
*      AND PERCH2(I), ARE DEFINED IN FIGURE 1D.  THESE TWO             *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*     LIMITS WILL PROVIDE A MAXIMUM OF THREE CHORDWISE STRIPS     *
*     WHERE THE AFT LIMIT OF THE THIRD CHORDWISE STRIP IS THE     *
*     SURFACE TRAILING EDGE.                                      *
*                                                                 *
*     THE SPANWISE STRIPS, DEPENDENT ON VARIABLE NSPNL(I), ARE    *
*     DEFINED IN FIGURE 1C.                                       *
*                                                                 *
*     THE CHORDWISE DIVISIONS, DEPENDENT ON VARIABLES             *
*     NCPL1(I), NCPL2(I), AND NCPL3(I), ARE DEFINED IN FIGURE     *
*     1E.                                                         *
*                                                                 *
*                                                                 *
*     REPEAT THE FOLLOWING ITEM FOR I= 1,...,NSA.                 *
*                                                                 *
*                                                                 *
* 18. ... PERCH1(I)       AFT LIMIT OF THE FIRST CHORDWISE        *
*     .                   STRIP IN THE I'TH SPANWISE AREA         *
*     .                   STARTING INBOARD, PERCENT CHORD.        *
*     .                                                           *
*     .   PERCH2(I)       AFT LIMIT OF THE SECOND CHORDWISE       *
*     .                   STRIP IN THE I'TH SPANWISE AREA,        *
*     .                   PERCENT CHORD.                          *
*     .                                                      N^SS *
*     .   NSPNL(I) ≦ 10   NUMBER OF SPANWISE STRIPS IN THE   _I   *
*     .                   I'TH SPANWISE AREA.                     *
*     .                                                      N^CP *
*     .   NCPL1(I) ≦ 7    NUMBER OF CHORDWISE DIVISIONS IN   _1I  *
*     .                   THE FIRST CHORDWISE STRIP AND THE       *
*     .                   I'TH SPANWISE AREA.                     *
*     .                                                      N^CP *
*     .   NCPL2(I) ≦ 7    NUMBER OF CHORDWISE DIVISIONS IN   _2I  *
*     .                   THE SECOND CHORDWISE STRIP AND THE      *
*     .                   I'TH SPANWISE AREA.                     *
*     .                                                      N^CP *
*     .   NCPL3(I) ≦ 7    NUMBER OF CHORDWISE DIVISIONS IN   _3I  *
*     .                   THE THIRD CHORDWISE STRIP AND THE       *
*     ...                 I'TH SPANWISE AREA.                     *
*                                                                 *
*     THE CHORDWISE PANELS ARE NUMBERED STARTING FROM THE TIP     *
*     LEADING EDGE MOVING AFT. AS INDICATED, EACH CHORDWISE       *
*     STRIP MAY CONTAIN UP TO SEVEN PANELS BUT THE TOTAL          *
*     NUMBER OF PANELS IN THE FORE-AFT DIRECTION MUST NOT         *
*     EXCEED SIXTEEN, THAT IS, NCPL1(I) + NCPL2(I) + NCPL3(I)     *
*     SHOULD BE EQUAL TO OR LESS THAN SIXTEEN.                    *
*     NOTEO  IF IN THE I'TH SPANWISE AREA THERE IS ONLY ONE       *
*     CHORDWISE STRIP WITH 6 CHORDWISE DIVISIONS AND 5            *
*     SPANWISE STRIPS, THEN DATA WOULD BE                         *
*     100.0 100.C   5   6   0   0.                                *
*                                                                 *
*     FORMAT = (2F6.2,4I4).  NUMBER OF CARDS IS NSA.              *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE L2.                          *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*****************************************************************
*                                                               *
*                                                               *
*     ENTER (FOUR VALUES OR LESS PER CARD) AND                  *
*     REPEAT THE FOLLOWING ITEM FOR I = 1,...,NSA1 = NSA+1.     *
*                                                               *
* 19. ... CORDI(I)        CHORD FOR I'TH SPANWISE AREA      CI  *
*       .                 BEGINNING WITH INBOARD CHORD OF       *
*       .                 FIRST SPANWISE AREA AND ENDING WITH   *
*       .                 OUTBOARD CHORD OF LAST SPANWISE       *
*       ...               AREA, IN.                             *
*                                                               *
*     SEE FIGURE 18.                                            *
*                                                               *
*     FORMAT = (4E12.4).  NUMBER OF CARDS IS (NSA1-1)/4 + 1.    *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE L2.                        *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*     C. INERTIAL LOADS                                         *
*     -----------------                                         *
*                                                               *
*****************************************************************
*                                                               *
* 20. ... LOGIC ITEM          *** NO DATA ***                   *
*                                                               *
*                                                               *
*     IF INERTIAL LOADS ARE TO BE CALCULATED (KLUEL(12) = 12)   *
*     READ THE FOLLOWING FOURTEEN ITEMS. OTHERWISE (KLUEL(12)   *
*     = 0) OMIT THESE ITEMS.                                    *
*                                                               *
*****************************************************************
*                                                               *
* 21. ... LA07            IDENTIFIES THE BEGINNING OF THE       *
*       .                 CARD INPUT DATA TO THE INERTIAL       *
*       .                 LOADS SUBMODULE, IN THE AUTOMATED     *
*       .                 LOAD ANALYSIS MODULE (ALAM). MUST     *
*       ...               BE ENTERED AS SHOWN.                  *
*                                                               *
*     USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE   *
*     AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT     *
*     THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO    *
*     SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION  *
*     THE USER WISHES TO INCLUDE.                               *
*                                                               *
*                                                               *
*     ------------                                              *
*     |0000000001|                                              *
*     |1234567890|                                              *
*     |----------|                                              *
*     |LA07|     |                                              *
```

ITEM	DATA	DESCRIPTION

FORMAT = (1A4). NUMBER OF CARDS IS 1.

DATA ARE ENTERED BY SUBROUTINE L7 AND SUBROUTINE LDB WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE PROPER HEADING FOR THE TABLE OF CONTENTS.

ITEM	DATA	DESCRIPTION	
22.	NWD ≤ 1000	NUMBER OF DISTRIBUTED WEIGHT GRID POINTS.	N_{WD}
	NW ≤ 1100	NUMBER OF DISTRIBUTED AND CONCENTRATED WEIGHT GRID POINTS.	N_W
	NFC	NUMBER OF FLIGHT CONDITIONS. NOTE THAT NFC PLUS NUMBER OF LOAD CONDITIONS ENTERED ON CARDS IN ASAM MUST BE EQUAL TO OR LESS THAN 8. ALSO NOTE - THE NUMBER OF FLIGHT CONDITIONS PRESCRIBED FOR AERODYNAMIC LOADS (WHEN KLUEL(4) = 4) IN ITEM 37 MUST HAVE THE SAME VALUE ASSIGNED IN THIS ITEM.	N_{FC}

FORMAT = (3I4). NUMBER OF CARDS IS 1.

DATA ARE ENTERED BY SUBROUTINE INERTL.

THE COORDINATES IN THE FOLLOWING FOUR ITEMS MUST BE SPECIFIED WITH RESPECT TO THE ORIGIN OF THE WEIGHTS GRID.

ITEM	DATA	DESCRIPTION	
23.	XREFI	X COORDINATE WHERE THE NORMAL LOAD FACTORS AND ANGULAR VELOCITIES AND ACCELERATIONS ARE MEASURED. POSITIVE AFT, IN.	X_R^I
	YREFI	Y COORDINATE WHERE THE NORMAL LOAD FACTORS AND ANGULAR VELOCITIES AND ACCELERATIONS ARE MEASURED, POSITIVE TO THE LEFT, IN.	Y_R^I
	ZREFI	Z COORDINATE WHERE THE NORMAL LOAD	Z_R^I

```
 ITEM     DATA              DESCRIPTION
 ----     ----              -----------

*      .                    FACTORS AND ANGULAR VELOCITIES AND       *
*      .                    ACCELERATIONS ARE MEASURED,              *
*      ...                  POSITIVE UP, IN.                         *
*                                                                    *
*     FORMAT = (3E12.4).  NUMBER OF CARDS IS 1.                      *
*                                                                    *
*     DATA ARE ENTERED BY SUBROUTINE INERTL.                         *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*     REPEAT THE FOLLOWING ITEM FOR K = 1,....NWD.                   *
*                                                                    *
* 24. ... XMW(K)            X COORDINATE OF THE K'TH            X^W  *
*      .                    DISTRIBUTED MASS CENTER OF GRAVITY.   K  *
*      .                    POSITIVE AFT, IN.                        *
*      .                                                             *
*      .   YMW(K)           Y COORDINATE OF THE K'TH            Y^W  *
*      .                    DISTRIBUTED MASS CENTER OF GRAVITY.   K  *
*      .                    POSITIVE TO THE LEFT, IN.                *
*      .                                                             *
*      .   ZMW(K)           Z COORDINATE OF THE K'TH            Z^W  *
*      .                    DISTRIBUTED MASS CENTER OF GRAVITY.   K  *
*      .                    POSITIVE UP, IN.                         *
*      .                                                             *
*      .   PMW(K)           WEIGHT OF K'TH DISTRIBUTED MASS,    m^W  *
*      ...                  LB.                                   K  *
*                                                                    *
*     FORMAT = (4E12.4).  NUMBER OF CARDS IS NWD.                    *
*                                                                    *
*     DATA ARE ENTERED BY SUBROUTINE INERTL.                         *
*                                                                    *
**********************************************************************
*                                                                    *
* 25. ... LOGIC ITEM          *** NO DATA ***                        *
*                                                                    *
*                                                                    *
*     IF DISTRIBUTED MASSES (KLUEL(5) = 0) ONLY ARE TO BE            *
*     INCLUDED OMIT THE FOLLOWING FIVE ITEMS, OTHERWISE IF           *
*     DISTRIBUTED AND CONCENTRATED MASSES ARE TO BE INCLUDED         *
*     (KLUEL(5) = 5) ENTER THE CONCENTRATED WEIGHTS, WHICH IS        *
*     THE FOLLOWING ITEM, AND ENTER THE MOMENTS AND PRODUCTS         *
*     OF INERTIA DEPENDING UPON THE ADDITIONAL CONTROL WORD          *
*     OPTION KLUEL(11). (SEE THE NEXT LOGIC ITEM.)                   *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*     REPEAT THE FOLLOWING FIVE ITEMS                                *
*     FOR KC = 1,....NWC = NW - NWD.                                 *
*                                                                    *
* 26. ... XMWC(KC)          X COORDINATE OF THE KC'TH           X^W  *
                                                                  CK
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

*       .                     CONCENTRATED MASS CENTER OF            *
*       .                     GRAVITY, POSITIVE AFT, IN.             *
*       .                                                            *
*       .  YMWC(KC)           Y COORDINATE OF THE KC'TH       y^W_CK *
*       .                     CONCENTRATED MASS CENTER OF            *
*       .                     GRAVITY, POSITIVE TO THE LEFT, IN      *
*       .                                                            *
*       .  ZMWC(KC)           Z COORDINATE OF THE KC'TH       z^W_CK *
*       .                     CONCENTRATED MASS CENTER OF            *
*       .                     GRAVITY, POSITIVE UP, IN.              *
*       .                                                            *
*       .  PMWC(KC)           WEIGHT OF KC'TH CONCENTRATED MASS, m^W_CK *
*       ...                   LB.                                    *
*                                                                    *
*       FORMAT = (4E12.4).  NUMBER OF CARDS IS 1, FOR THE KC'TH      *
*       CONCENTRATED MASS.                                           *
*                                                                    *
*       DATA ARE ENTERED BY SUBROUTINE INERTL.                       *
*                                                                    *
**********************************************************************
*                                                                    *
* 27. ... LOGIC ITEM            *** NO DATA ***                      *
*                                                                    *
*                                                                    *
*       IF A LIMITED NUMBER OF LOAD COMPONENTS ARE TO BE             *
*       CALCULATED (KLUEL(11) = 0) READ THE FIRST AND OMIT THE       *
*       SECOND AND THIRD OF THE FOLLOWING THREE ITEMS, OTHERWISE     *
*       IF ALL FORCE AND MOMENT COMPONENTS ARE TO BE CALCULATED      *
*       (KLUEL(11) = 11) OMIT THE FIRST AND READ THE SECOND AND      *
*       THIRD OF THE FOLLOWING THREE ITEMS.                          *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
* 28. ... PIYYW(KC)           MOMENT OF INERTIA ABOUT THE Y AXIS I^W_yyK *
*       .                     AT THE KC'TH WEIGHTS GRID CENTER OF    *
*       ...                   GRAVITY POSITION, IN**2 - LB.          *
*                                                                    *
*       FORMAT = (12X,E12.4,12X).  NUMBER OF CARDS IS 1, FOR THE     *
*       KC'TH CONCENTRATED MASS.                                     *
*                                                                    *
*       DATA ARE ENTERED BY SUBROUTINE INERTL.                       *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
* 29. ... PIXXW(KC)           MOMENT OF INERTIA ABOUT THE X AXIS I^W_xxK *
*       .                     AT THE KC'TH WEIGHTS GRID CENTER OF    *
*       .                     GRAVITY POSITION, IN**2 - LB.          *
*       .                                                            *
*       .  PIYYW(KC)          MOMENT OF INERTIA ABOUT THE Y AXIS I^W_yyK *
*       .                     AT THE KC'TH WEIGHTS GRID CENTER OF    *
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

*      .                      GRAVITY POSITION. IN**2 - LB.                  *
*      .                                                                     *
*      .   PIZZW(KC)          MOMENT OF INERTIA ABOUT THE Z AXIS  I_ZZK^W    *
*      .                      AT THE KC'TH WEIGHTS GRID CENTER OF            *
*      ...                    GRAVITY POSITION. IN**2 - LB.                  *
*                                                                            *
*      FORMAT = (3E12.4).  NUMBER OF CARDS IS 1, FOR THE KC'TH               *
*      CONCENTRATED MASS.                                                    *
*                                                                            *
*      DATA ARE ENTERED BY SUBROUTINE INERTL.                                *
*                                                                            *
******************************************************************************
*                                                                            *
*                                                                            *
* 30.  ... PIXYW(KC)          PRODUCT OF INERTIA ABOUT THE X-Y   I_XYK^W     *
*      .                      AXES AT THE KC'TH WEIGHTS GRID                 *
*      .                      CENTER OF GRAVITY POSITION,                    *
*      .                      POSITIVE FOR DIRECTIONS                        *
*      .                      CORRESPONDING TO LEFT HAND AXES                *
*      .                      WITH Z POSITIVE UP, IN**2 - LB.                *
*      .                                                                     *
*      .   PIXZW(KC)          PRODUCT OF INERTIA ABOUT THE X-Z   I_XZK^W     *
*      .                      AXES AT THE KC'TH WEIGHTS GRID                 *
*      .                      CENTER OF GRAVITY POSITION,                    *
*      .                      POSITIVE FOR DIRECTIONS                        *
*      .                      CORRESPONDING TO LEFT HAND AXES                *
*      .                      WITH Z POSITIVE UP, IN**2 - LB.                *
*      .                                                                     *
*      .   PIYZW(KC)          PRODUCT OF INERTIA ABOUT THE Y-Z   I_YZK^W     *
*      .                      AXES AT THE KC'TH WEIGHTS GRID                 *
*      .                      CENTER OF GRAVITY POSITION,                    *
*      .                      POSITIVE FOR DIRECTIONS                        *
*      .                      CORRESPONDING TO LEFT HAND AXES                *
*      ...                    WITH Z POSITIVE UP, IN**2 - LB.                *
*                                                                            *
*      FORMAT = (3E12.4).  NUMBER OF CARDS IS 1, FOR THE KC'TH               *
*      CONCENTRATED MASS.                                                    *
*                                                                            *
*      DATA ARE ENTERED BY SUBROUTINE INERTL.                                *
*                                                                            *
******************************************************************************
*                                                                            *
*                                                                            *
*      REPEAT THE FOLLOWING FOUR ITEMS                                       *
*      FOR EACH FLIGHT CONDITION FOR J = 1,...,NFC.                          *
*                                                                            *
*      ENTER (FIFTEEN VALUES PER CARD)                                       *
*      FOR THE J'TH FLIGHT CONDITION FOR L = 1,...,15.                       *
*                                                                            *
* 31.  ... TITLEJ(L,J)        TITLE DEFINING THE J'TH FLIGHT                 *
*      ...                    CONDITION.                                     *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     FORMAT = (15A4).  NUMBER OF CARDS IS 1, FOR THE J'TH          *
*     FLIGHT CONDITION.                                             *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE INERTL.                        *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
*     ENTER (THREE VALUES PER CARD)                                 *
*     FOR THE J'TH FLIGHT CONDITION                                 *
*                                                                   *
* 32. ... PVEL(J)          RIGID BODY ROLL VELOCITY ABOUT X     P   *
*     .                    AXIS PASSING THROUGH YREFI, ZREFI,       *
*     .                    POSITIVE RIGHT SIDE DOWN, RAD/SEC.       *
*     .                                                             *
*     .   QVEL(J)          RIGID BODY PITCH VELOCITY ABOUT Y    Q   *
*     .                    AXIS PASSING THROUGH XREFI, ZREFI,       *
*     .                    POSITIVE NOSE UP, RAD/SEC.               *
*     .                                                             *
*     .   RVEL(J)          RIGID BODY YAW VELOCITY ABOUT Z      R   *
*     .                    AXIS PASSING THROUGH XREFI, YREFI,       *
*     ...                  POSITIVE NOSE RIGHT, RAD/SEC.            *
*                                                                   *
*     FORMAT = (3E12.4).  NUMBER OF CARDS IS 1, FOR THE J'TH        *
*     FLIGHT CONDITION.                                             *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE INERTL.                        *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
*     ENTER (THREE VALUES PER CARD)                                 *
*     FOR THE J'TH FLIGHT CONDITION                                 *
*                                                                   *
* 33. ... PACC(J)          RIGID BODY ROLL ACCELERATION ABOUT   Ṗ   *
*     .                    X AXIS PASSING THROUGH YREFI,            *
*     .                    ZREFI, POSITIVE RIGHT SIDE DOWN,         *
*     .                    RAD/SEC**2.                              *
*     .                                                             *
*     .   QACC(J)          RIGID BODY PITCH ACCELERATION ABOUT  Q̇   *
*     .                    Y AXIS PASSING THROUGH XREFI,            *
*     .                    ZREFI, POSITIVE NOSE UP,                 *
*     .                    RAD/SEC**2.                              *
*     .                                                             *
*     .   RACC(J)          RIGID BODY YAW ACCELERATION ABOUT Z  Ṙ   *
*     .                    AXIS PASSING THROUGH XREFI, YREFI,       *
*     ...                  POSITIVE NOSE RIGHT, RAD/SEC**2.         *
*                                                                   *
*     FORMAT = (3E12.4).  NUMBER OF CARDS IS 1, FOR THE J'TH        *
*     FLIGHT CONDITION.                                             *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE INERTL.                        *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*******************************************************************
*                                                                 *
*                                                                 *
*     ENTER (THREE VALUES PER CARD)                               *
*     FOR THE J'TH FLIGHT CONDITION                               *
*                                                                 *
* 34. ... FACX(J)          RIGID BODY LOAD FACTOR IN THE X    Nx  *
*     .                    DIRECTION, POSITIVE AFT, G'S.          *
*     .                                                           *
*     .   FACY(J)          RIGID BODY LOAD FACTOR IN THE Y    Ny  *
*     .                    DIRECTION. POSITIVE TO THE LEFT,       *
*     .                    G'S.                                   *
*     .                                                           *
*     .   FACZ(J)          RIGID BODY LOAD FACTOR IN THE Z    Nz  *
*     ...                  DIRECTION, POSITIVE UP, G'S.           *
*                                                                 *
*     FORMAT = (3E12.4).  NUMBER OF CARDS IS 1, FOR THE J'TH      *
*     FLIGHT CONDITION.                                           *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE INERTL.                      *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*     D.  AERODYNAMIC LOADS                                       *
*     ---------------------                                       *
*                                                                 *
*******************************************************************
*                                                                 *
* 35. ... LOGIC ITEM          *** NO DATA ***                     *
*                                                                 *
*                                                                 *
*     IF AERODYNAMIC LOADS ARE TO BE CALCULATED (KLUEL(4) = 4)    *
*     READ THE FOLLOWING TWENTY FIVE ITEMS. OTHERWISE             *
*     (KLUEL(4) = 0) OMIT THESE ITEMS.                            *
*                                                                 *
*******************************************************************
*                                                                 *
* 36. ... LA04             IDENTIFIES THE BEGINNING OF THE        *
*     .                    CARD INPUT DATA TO THE AERODYNAMIC     *
*     .                    LOADS SUBMODULE IN THE AUTOMATED       *
*     .                    LOAD ANALYSIS MODULE (ALAM). MUST      *
*     ...                  BE ENTERED AS SHOWN.                   *
*                                                                 *
*     USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE     *
*     AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT       *
*     THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO      *
*     SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION    *
*     THE USER WISHES TO INCLUDE.                                 *
*                                                                 *
*     ----------                                                  *
*     |C000000001|                                                *
```

```
ITEM      DATA                  DESCRIPTION
----      ----                  -----------

*       |1234567890|                                                    *
*       |----------|                                                    *
*       |LA04|     |                                                    *
*       |----------|                                                    *
*                                                                       *
*       FORMAT = (1A4).  NUMBER OF CARDS IS 1.                          *
*                                                                       *
*       DATA ARE ENTERED BY SUBROUTINE L4 AND SUBROUTINE LDB            *
*       WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE         *
*       PROPER HEADING FOR THE TABLE OF CONTENTS.                       *
*                                                                       *
*************************************************************************
*                                                                       *
* 37. ... NMAT≤NFC          TOTAL NUMBER OF DIFFERENT SUBSONIC          *
*       .                   AND/OR SUPERSONIC AERODYNAMIC               *
*       .                   INFLUENCE COEFFICIENT MATRICES              *
*       .                   (SYMMETRIC AND ANTISYMMETRIC                *
*       .                   MATRICES ARE COUNTED AS ONE) THAT           *
*       .                   MUST BE USED.                               *
*       .                                                               *
*       .   NFC             NUMBER OF FLIGHT CONDITIONS.          N_FC  *
*       .                   NOTE THAT NFC PLUS NUMBER OF LOAD           *
*       .                   CONDITIONS ENTERED ON CARDS IN ASAM         *
*       .                   MUST BE EQUAL TO OR LESS THAN 8.            *
*       .                   NFC SHOULD HAVE THE SAME VALUE AS           *
*       .                   ITEM 22 ABOVE WHEN INERTIAL LOADS           *
*       .                   ARE ALSO BEING COMPUTED.                    *
*       .                                                               *
*       ... NCS≤8           NUMBER OF CONTROL SURFACES.           N_CS  *
*                                                                       *
*       FORMAT = (3I4).  NUMBER OF CARDS IS 1.                          *
*                                                                       *
*       DATA ARE ENTERED BY SUBROUTINE ONE.                             *
*                                                                       *
*************************************************************************
*                                                                       *
*                                                                       *
*       ENTER (TEN NUMBERS OR LESS PER CARD) AND                        *
*       REPEAT THE FOLLOWING ITEM FOR I = 1,...,NMAT.                   *
*                                                                       *
* 38. ... NUMCO(I)          NUMBER OF TIMES THE I'TH                    *
*       .                   AERODYNAMIC INFLUENCE COEFFICIENT           *
*       ...                 MATRIX IS TO BE USED.                       *
*                                                                       *
*       FOR EXAMPLE IF THE AERODYNAMIC INFLUENCE COEFFICIENT            *
*       MATRIX AT M = 0.6 IS TO BE USED FOR TWO FLIGHT                  *
*       CONDITIONS THEN NUMCO(I) = 2.  FLIGHT CONDITIONS MUST BE        *
*       ARRANGED AS FAR AS MACH NUMBER IS CONCERNED IN THE SAME         *
*       ORDER AS THE INCOMING AERODYNAMIC INFLUENCE                     *
*       COEFFICIENTS. REPEAT FOR EACH MACH NUMBER. A ZERO VALUE         *
*       INDICATES THAT THE I'TH AERODYNAMIC INFLUENCE                   *
*       COEFFICIENT MATRIX IS NOT TO BE OPERATED ON.                    *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*     NOTE THAT THE SUM OF NUMCC(I) EQUALS NFC.                       *
*                                                                     *
*     FORMAT = (10I4).  NUMBER OF CARDS IS (NMAT-1)/10 +1.            *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE ONE.                             *
*                                                                     *
***********************************************************************
*                                                                     *
*     ENTER (TEN VALUES OR LESS PER CARD) AND                         *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....,NUMF,                    *
*     WHERE NUMF = SUM OF (NSPNL(I)) FOR I=1,...,NSA.                 *
*                                                                     *
* 39. ... NCH(I)             TRAILING EDGE PANEL NUMBER OF THE        *
*     .                      I'TH SPANWISE STRIP STARTING WITH        *
*     .                      THE OUTBOARD STRIP AND MOVING            *
*     ...                    INBOARD.                                 *
*                                                                     *
*     SEE FIGURE 2.                                                   *
*                                                                     *
*     FORMAT = (10I4).  NUMBER OF CARDS IS (NUMF-1)/10 +1.            *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE ONE.                             *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
* 40. ... ACI                ANGLE OF INCIDENCE OF SURFACE      αI    *
*     .                      RELATIVE TO FUSELAGE REFERENCE           *
*     .                      LINE. POSITIVE LEADING EDGE UP,          *
*     ...                    DEG.                                     *
*                                                                     *
*     FORMAT = (1E12.4).  NUMBER OF CARDS IS 1.                       *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE ONE.                             *
*                                                                     *
***********************************************************************
*                                                                     *
* 41. ... LOGIC ITEM            *** NO DATA ***                       *
*                                                                     *
*     IF CONTROL SURFACES ARE NOT INCLUDED (NCS EQUAL TO ZERO)        *
*     OMIT THE FOLLOWING ITEM, OTHERWISE (NCS GREATER THAN OR         *
*     EQUAL TO ONE) ENTER DATA FOR THE FOLLOWING ITEM.                *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*     REPEAT THE FOLLOWING ITEM FOR K = 1,....,NCS.                   *
*                                                                     *
*     ENTER (EIGHT VALUES OR LESS PER CARD) AND                       *
*     REPEAT THE FOLLOWING ITEM FOR I= 1,....,ITOT.                   *
*                                                                     *
* 42. ... U(I,K)             FRACTION OF THE I'TH PANEL THAT    Un    *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*      ...                  LIES ON THE K'TH CONTROL SURFACE.              *
*                                                                          *
*      FORMAT = (8F6.2).    NUMBER OF CARDS IS NCS*((ITOT-1)/8 +           *
*      1).                                                                 *
*                                                                          *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                                 *
*                                                                          *
****************************************************************************
*                                                                          *
* 43.  ... LOGIC ITEM           *** NO DATA ***                            *
*                                                                          *
*                                                                          *
*      IF CAMBER ANGLES ARE TO BE INCLUDED (KLUEL(9) = 9) ENTER            *
*      THE FOLLOWING ITEM, OTHERWISE (KLUEL(9) = 0) OMIT THIS              *
*      ITEM.                                                               *
*                                                                          *
****************************************************************************
*                                                                          *
*                                                                          *
*      REPEAT THE FOLLOWING ITEM FOR I= 1,...,ITOT.                        *
*                                                                          *
* 44.  ... B(I)             INCREMENTAL LOCAL ANGLE OF ATTACK       α2     *
*      .                    DUE TO CAMBER AND TWIST AT THE I'TH            *
*      ...                  PANEL CENTER, RAD.                             *
*                                                                          *
*      FORMAT = (E12.4).    NUMBER OF CARDS IS ITOT.                       *
*                                                                          *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                                 *
*                                                                          *
****************************************************************************
*                                                                          *
*                                                                          *
*      THE FOLLOWING ITEM SHOULD BE ENTERED IN THE COORDINATE              *
*      SYSTEM OF THE AERODYNAMIC SURFACE INDICATED IN FIGURE 1.            *
*                                                                          *
*                                                                          *
* 45.  ... XREF             X COORDINATE WHERE OVERALL              XR     *
*      .                    AERODYNAMIC FORCES AND MOMENTS ARE             *
*      .                    DESIRED, IN.                                   *
*      .                                                                   *
*      .   YREF             Y COORDINATE WHERE OVERALL              YR     *
*      .                    AERODYNAMIC FORCES AND MOMENTS ARE             *
*      .                    DESIRED, IN.                                   *
*      .                                                                   *
*      .   ZREF             Z COORDINATE WHERE OVERALL              ZR     *
*      .                    AERODYNAMIC FORCES AND MOMENTS ARE             *
*      ...                  DESIRED, IN.                                   *
*                                                                          *
*      FORMAT = (3E12.4).   NUMBER OF CARDS IS 1.                          *
*                                                                          *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                                 *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*****************************************************************
*                                                               *
*     REPEAT THE FOLLOWING FIFTEEN ITEMS                        *
*     FOR EACH FLIGHT CONDITION FOR J = 1,...,NFC.              *
*                                                               *
*                                                               *
*     ENTER (SIXTEEN VALUES PER CARD)   FOR L = 1,...,16.       *
*                                                               *
* 46. ... TITLE(J,L)      TITLE DEFINING THE J'TH FLIGHT        *
*     ...                 CONDITION.                            *
*                                                               *
*     FORMAT = (16A4).  NUMBER OF CARDS IS 1, FOR THE J'TH      *
*     FLIGHT CONDITION.                                         *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE ONE.                       *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
* 47. ... AM(J)           MACH NUMBER FOR J'TH FLIGHT        M  *
*     .                   CONDITION.                            *
*     .                                                         *
*     .   Q(J)            DYNAMIC PRESSURE FOR J'TH FLIGHT   q  *
*     .                   CONDITION, LB/IN**2.                  *
*     .                                                         *
*     .   ALFT(J)         ANGLE OF ATTACK OF FUSELAGE       αF  *
*     .                   REFERENCE LINE FOR J'TH FLIGHT        *
*     .                   CONDITION, DEG.                       *
*     .                                                         *
*     .   KSYM(J) = 1     SYMMETRIC PROBLEM FOR J'TH FLIGHT     *
*     .                   CONDITION.                            *
*     .           = 2     ASYMMETRIC PROBLEM FOR J'TH FLIGHT    *
*     ...                 CONDITION.                            *
*                                                               *
*     FORMAT = (3E12.4,1I4).  NUMBER OF CARDS IS 1, FOR THE     *
*     J'TH FLIGHT CONDITION.                                    *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE ONE.                       *
*                                                               *
*****************************************************************
*                                                               *
*     ENTER ZERO FOR FIRST VARIABLE IN THIS ITEM (CAMF(J))      *
*     WHEN KLUEL(9) = 0.                                        *
*                                                               *
*                                                               *
* 48. ... CAMF(J)         SCALAR FACTOR ON INCREMENTAL ANGLE K2 *
*     .                   OF ATTACK DISTRIBUTION DUE TO         *
*     .                   CAMBER AND TWIST.                     *
*     .                   IF TRUE VALUES ARE DESIRED ENTER      *
*     .                   UNITY FOR THIS VARIABLE.              *
*     .                                                         *
*     .   AIFAC(J)        SCALAR FACTOR ON INCIDENCE ANGLE OF K1 *
```

```
ITEM      DATA               DESCRIPTION
----      ----               -----------

*       .                    WING WITH RESPECT TO FUSELAGE.             *
*       .                    IF TRUE VALUES ARE DESIRED ENTER           *
*       ...                  UNITY FOR THIS VARIABLE.                   *
*                                                                       *
*       FORMAT = (2E12.4).  NUMBER OF CARDS IS 1, FOR THE J'TH          *
*       FLIGHT CONDITION.                                               *
*                                                                       *
*       DATA ARE ENTERED BY SUBROUTINE ONE.                             *
*                                                                       *
*************************************************************************
*                                                                       *
* 49. ... LOGIC ITEM              *** NO DATA ***                       *
*                                                                       *
*       IF CONTROL SURFACES ARE NOT INCLUDED (NCS EQUAL TO ZERO)        *
*       OMIT THE FOLLOWING ITEM, OTHERWISE (NCS GREATER THAN OR         *
*       EQUAL TO ONE) ENTER DATA FOR THE FOLLOWING ITEM.                *
*                                                                       *
*************************************************************************
*                                                                       *
*                                                                       *
*       ENTER (EIGHT VALUES OR LESS PER CARD) AND                       *
*       REPEAT THE FOLLOWING ITEM FOR K = 1,....,NCS.                   *
*                                                                       *
* 50. ... DEL(K,J)           ROTATION OF THE K'TH LEFT CONTROL   δ_LK   *
*       .                    SURFACE FOR THE J'TH FLIGHT                *
*       .                    CONDITION, POSITIVE TRAILING EDGE          *
*       .                    DOWN, DEG.                                 *
*       .                                                               *
*       .  DER(K,J)          ROTATION OF THE K'TH RIGHT CONTROL  δ_RK   *
*       .                    SURFACE FOR THE J'TH FLIGHT                *
*       .                    CONDITION, POSITIVE TRAILING EDGE          *
*       ...                  DOWN, DEG.                                 *
*                                                                       *
*       FORMAT = (8F6.2).  NUMBER OF CARDS IS (NCS-1)/4 + 1, FOR        *
*       J'TH FLIGHT CONDITION.                                          *
*                                                                       *
*       DATA ARE ENTERED BY SUBROUTINE ONE.                             *
*                                                                       *
*************************************************************************
*                                                                       *
* 51. ... LOGIC ITEM              *** NO DATA ***                       *
*                                                                       *
*                                                                       *
*       IF SOME OR ALL OF THE CORRECTION FACTORS ARE TO BE              *
*       SUPPLIED BY THE USER (KLUEL(10) = 10) ENTER THE                 *
*       FOLLOWING NINE ITEMS, OTHERWISE (KLUEL(10) = 0) OMIT            *
*       THESE ITEMS.                                                    *
*                                                                       *
*************************************************************************
*                                                                       *
*                                                                       *
* 52. ... KC1(J)             CONTROL WORD OPTION ASSOCIATED WITH        *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*       .                    THE RIGID-SURFACE ANGLE-OF-ATTACK       *
*       .                    SCALAR CORRECTION FACTORS, C1(I,J),     *
*       .                    FOR THE J'TH FLIGHT CONDITION.          *
*       .            =  0    CORRECTION FACTORS, C1(I,J), ARE        *
*       .                    NOT ENTERED.                            *
*       .            =  J    ALL CORRECTION FACTORS, C1(I,J),        *
*       .                    ARE ENTERED.                            *
*       .            = -J    ONE CORRECTION FACTOR, C1(1,J),         *
*       .                    APPLICABLE TO ALL PANELS IS ENTERED     *
*       .                                                            *
*       .  KF1(J)            CONTROL WORD OPTION ASSOCIATED WITH     *
*       .                    F1(I,J), THE ADDITIVE CORRECTION TO     *
*       .                    THE RIGID-SURFACE ANGLE-OF-ATTACK       *
*       .                    DISTRIBUTION FOR THE J'TH FLIGHT        *
*       .                    CONDITION.                              *
*       .            =  0    CORRECTIONS, F1(I,J), ARE NOT           *
*       .                    ENTERED.                                *
*       .            =  J    ALL CORRECTIONS, F1(I,J), ARE           *
*       .                    ENTERED.                                *
*       .            = -J    ONE CORRECTION, F1(1,J), APPLICABLE     *
*       ...                  TO ALL PANELS, IS ENTERED.              *
*                                                                    *
*      FORMAT = (2I4).  NUMBER OF CARDS IS 1, FOR THE J'TH           *
*      FLIGHT CONDITION.                                             *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                           *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*      IF KC1(J) =  J, IMAX = ITOT,                                  *
*      IF KC1(J) = -J, IMAX = 1,                                     *
*      IF KC1(J) =  0, OMIT THE FOLLOWING ITEM.                      *
*                                                                    *
*      ENTER (FOUR VALUES OR LESS PER CARD) AND                      *
*      REPEAT THE FOLLOWING ITEM FOR I = 1,...,IMAX.                 *
*                                                                    *
* 53.  ... C1(I,J)           SCALAR CORRECTION FACTORS ON ANGLE  C1  *
*       .                    OF ATTACK DUE TO FUSELAGE INCIDENCE     *
*       .                    FOR THE J'TH FLIGHT CONDITION AND       *
*       ...                  I'TH PANEL.                             *
*                                                                    *
*      FORMAT = (4E12.4).  NUMBER OF CARDS IS (IMAX-1)/4 + 1,        *
*      FOR THE J'TH FLIGHT CONDITION.                                *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                           *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*      IF KF1(J) =  0, OMIT THE FOLLOWING TWO ITEMS.                 *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

* 54. ... FL1(J)              SCALAR FACTOR ON F1(I,J), THE          K3  *
*         .                   ADDITIVE CORRECTION TO THE                 *
*         .                   RIGID-SURFACE ANGLE-OF-ATTACK              *
*         .                   DISTRIBUTION FOR THE J'TH FLIGHT           *
*         ...                 CONDITION.                                 *
*                                                                        *
*     FORMAT = (1E12.4).  NUMBER OF CARDS IS 1. FOR THE J'TH             *
*     FLIGHT CONDITION.                                                  *
*                                                                        *
*     DATA ARE ENTERED BY SUBROUTINE ONE.                                *
*                                                                        *
**************************************************************************
*                                                                        *
*                                                                        *
*     IF KF1(J) =  J, IMAX = ITCT,                                       *
*     IF KF1(J) = -J, IMAX = 1.                                          *
*                                                                        *
*                                                                        *
*     ENTER (FOUR VALUES OR LESS PER CARD) AND                           *
*     AND REPEAT THE FOLLOWING ITEM FOR I = 1.....IMAX.                  *
*                                                                        *
* 55. ... F1(I,J)             ADDITIVE CORRECTION TO THE             α3  *
*         .                   RIGID-SURFACE ANGLE-OF-ATTACK FOR          *
*         .                   THE J'TH FLIGHT CONDITION AND I'TH         *
*         ...                 PANEL, DEG.                                *
*                                                                        *
*     FORMAT = (4E12.4).  NUMBER OF CARDS IS (IMAX-1)/4 + 1.             *
*     FOR THE J'TH FLIGHT CONDITION.                                     *
*                                                                        *
*     DATA ARE ENTERED BY SUBROUTINE ONE.                                *
*                                                                        *
**************************************************************************
*                                                                        *
* 56. ... LOGIC ITEM              *** NO DATA ***                        *
*                                                                        *
*     IF CONTROL SURFACES ARE NOT INCLUDED (NCS EQUAL TO ZERO)           *
*     OMIT THE FOLLOWING FOUR ITEMS, OTHERWISE (NCS GREATER              *
*     THAN OR EQUAL TO ONE) ENTER DATA FOR THESE ITEMS.                  *
*                                                                        *
**************************************************************************
*                                                                        *
*                                                                        *
*     ENTER (TEN VALUES OR LESS PER CARD) AND                            *
*     REPEAT THE FOLLOWING ITEM FOR K = 1,...,NCS.                       *
*                                                                        *
* 57. ... KCR(K,J)            CONTROL WORD OPTION ASSOCIATED WITH        *
*         .                   THE RIGID-CONTROL-SURFACE ANGLE            *
*         .                   OF-ROTATION SCALAR CORRECTION              *
*         .                   FACTORS, CRT(I,K), FOR THE J'TH            *
*         .                   FLIGHT CONDITION AND K'TH CONTROL          *
*         .                   SURFACE.                                   *
*         .               = 0 CORRECTION FACTORS, CRT(I,K), ARE          *
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

*      .                      NOT ENTERED.                                  *
*      .               =  J   ALL CORRECTION FACTORS, CRT(I,K),             *
*      .                      ARE ENTERED.                                  *
*      .               = -J   ONE CORRECTION FACTOR, CRT(1,K), IS           *
*      .                      ENTERED.                                      *
*      .                                                                    *
*      .   KFR(K,J)           CONTROL WORD OPTION ASSOCIATED WITH           *
*      .                      FR(I,K), THE ADDITIVE CORRECTION TO           *
*      .                      THE RIGID-CONTROL-SURFACE ANGLE OF            *
*      .                      ROTATION FOR THE J'TH FLIGHT                  *
*      .                      CONDITION AND K'TH CONTROL SURFACE.           *
*      .               =  0   CORRECTIONS, FR(I,K), ARE NOT                 *
*      .                      ENTERED.                                      *
*      .               =  J   ALL CORRECTIONS, FR(I,K), ARE                 *
*      .                      ENTERED.                                      *
*      .               = -J   ONE CORRECTION, FR(1,K), APPLICABLE           *
*      ...                    TO ALL PANELS, IS ENTERED.                    *
*                                                                           *
*      FORMAT = (10I4).  NUMBER OF CARDS IS (NCS-1)/5 + 1, FOR              *
*      THE J'TH FLIGHT CONDITION.                                           *
*                                                                           *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                                  *
*                                                                           *
*****************************************************************************
*                                                                           *
*      REPEAT THE FOLLOWING ITEM FOR K = 1,...,NCS.                         *
*                                                                           *
*      IF KCR(K,J) =  J, IMAX = ITOT,                                       *
*      IF KCR(K,J) = -J, IMAX = 1,                                          *
*      IF KCR(K,J) =  0, OMIT THE FOLLOWING ITEM.                           *
*                                                                           *
*      ENTER (FOUR VALUES OR LESS PER CARD) AND                             *
*      REPEAT THE FOLLOWING ITEM FOR I = 1,...,IMAX.                        *
*                                                                           *
*                                                                           *
* 58.  ... CRT(I,K)           RIGID-CONTROL-SURFACE                     G2  *
*      .                      ANGLE-OF-ROTATION SCALAR CORRECTION           *
*      .                      FACTORS FOR THE J'TH FLIGHT                   *
*      .                      CONDITION, K'TH CONTROL SURFACE,              *
*      ...                    AND I'TH PANEL.                               *
*                                                                           *
*      FORMAT = (4E12.4).  NUMBER OF CARDS IS NCS*((IMAX-1)/4 +             *
*      1), FOR THE J'TH FLIGHT CONDITION.                                   *
*                                                                           *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                                  *
*                                                                           *
*****************************************************************************
*                                                                           *
*                                                                           *
*      REPEAT THE FOLLOWING TWO ITEMS FOR K = 1,...,NCS,                    *
*      EXCEPT,                                                              *
*      IF KFR(K,J) = 0, OMIT THE FOLLOWING TWO ITEMS.                       *
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

* 59. ... FLR(K,J)           SCALAR FACTOR ON FR(I,K), THE        K4 *
*      .                     ADDITIVE CORRECTION TO THE              *
*      .                     RIGID-CONTROL-SURFACE ANGLE OF          *
*      .                     ROTATION FOR THE J'TH FLIGHT            *
*      ...                   CONDITION AND K'TH CONTROL SURFACE.     *
*                                                                    *
*      FORMAT = (1E12.4).  NUMBER OF CARDS IS 1 FOR THE J'TH         *
*      FLIGHT CONDITION AND K'TH CONTROL SURFACE.                    *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                           *
*                                                                    *
**********************************************************************
*                                                                    *
*      IF KFR(K,J) =  J, IMAX = ITOT,                                *
*      IF KFR(K,J) = -J, IMAX = 1,                                   *
*                                                                    *
*      ENTER (FOUR VALUES OR LESS PER CARD) AND                      *
*      REPEAT THE FOLLOWING ITEM FOR I = 1,..., IMAX.                *
*                                                                    *
* 60. ... FR(I,K)            ADDITIVE CORRECTION TO THE          δ2  *
*      .                     RIGID-CONTROL-SURFACE ANGLE OF          *
*      .                     ROTATION FOR THE J'TH FLIGHT            *
*      .                     CONDITION, K'TH CONTROL SURFACE,        *
*      ...                   AND I'TH PANEL, DEG.                    *
*                                                                    *
*      FORMAT = (4E12.4).  NUMBER OF CARDS IS (IMAX-1)/4 + 1         *
*      FOR THE J'TH FLIGHT CONDITION AND K'TH CONTROL SURFACE.       *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE ONE.                           *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*      E. TOTAL LOADS                                                *
*      --------------                                                *
*                                                                    *
*                                                                    *
*      CARD DATA ARE NOT REQUIRED IN THIS SECTION.                   *
*      THE CONTROL WORD OPTION KLUEL(22) DETERMINES THE              *
*      CALCULATION OF TOTAL LOADS IN THE STRUCTURES GRID.            *
*                                                                    *
**********************************************************************
```

ASAM/ASOM

AUTOMATED STRENGTH ANALYSIS/OPTIMIZATION MODULE

I. PREPARATICN OF CARD DATA

CARD INPUT DATA MUST ALWAYS BE ENTERED FOR THE MAIN PRCGRAM. REMAINING DATA WILL DEPEND UPON THE OPTIONS THE USER IS EXERCISING.

INFORMATION PROVIDED IN THE FCLLOWING SECTIONS IS INTENDED PRIMARILY TO BE USED FOR THE PREPARATION OF DATA TC BE PUNCHED ON CARDS. MORE GENERAL TYPE INFORMATION ABOUT PROGRAM CAPABILITIES IS PRESENTED IN THE 'PROGRAM APPLICATICN' SECTION.

A. GENERAL DESCRIPTION AND LIMITATIONS

THE STRENGTH ANALYSIS PROGRAM REQUIRES THE FOLLOWING DATA.

ITEM	DATA	DESCRIPTION
1.	SAC0	IDENTIFIES THE BEGINNING OF THE CARD INPUT DATA TO THE AUTOMATED STRUCTURAL ANALYSIS AND OPTIMIZATION MODULES (ASAM AND ASOM). MUST BE ENTERED AS SHOWN.

USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE AND REFERENCE PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT THE END OF EACH EXECUTION. REMAINING COLUMNS (FIVE TO SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION THE USER WISHES TO INCLUDE.

```
 ----------
|0000000001|
|1234567890|
|----------|
|SA00|     |
 ----------
```

FORMAT = (1A4). NUMBER OF CARDS IS 1.

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     DATA ARE ENTERED BY SUBROUTINE ASAM AND SUBROUTINE LDB     *
*     WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE    *
*     PROPER HEADING FOR THE TABLE OF CONTENTS.                  *
*                                                                *
******************************************************************
*                                                                *
*                                                                *
*     ENTER (SIXTEEN WORDS PER CARD)                             *
*     FOR THE FOLLOWING ITEM FOR L= 1,....,16.                   *
*                                                                *
*  2. ... TSHS(L)          SUBTITLE CONSISTING OF ONE CARD.      *
*                                                                *
*     WILL BE LISTED AFTER THE MAIN TITLE AT THE TOP OF EACH     *
*     PAGE OF THE LISTED RESULTS AND WILL BE USED TO DEFINE      *
*     THE TYPE OF STRENGTH ANALYSIS BEING PERFORMED. THE         *
*     SUBTITLE IS INCREASED TO EIGHTEEN WORDS WITHIN THE         *
*     PROGRAMS WHERE THE LAST TWO WORDS ARE USED TO IDENTIFY     *
*     THE PROGRAM FROM WHICH RESULTS ARE LISTED.                 *
*                                                                *
*     FORMAT = (16A4).  NUMBER OF CARDS IS 1.                    *
*                                                                *
*     DATA ARE ENTERED BY SUBROUTINE ASAM.                       *
*                                                                *
******************************************************************
*                                                                *
*                                                                *
*        ALL CLUE VALUES INCLUDING ZEROS MAY BE ENTERED IF THE   *
*     USER SO DESIRES.  IF THIS APPROACH IS TAKEN A CARD         *
*     CONTAINING ONLY ZEROES SHOULD NOT BE INCLUDED AS DATA.     *
*     IF THE USER WISHES TO MINIMIZE THE AMOUNT OF DATA, HE      *
*     MAY ENTER ONLY NON-ZERO CLUE VALUES ACCORDING TO THE       *
*     PROCEDURE DISCUSSED IN 'CONTROL WORD OPTION' SECTION.      *
*     REGARDLESS OF WHICH APPROACH IS TAKEN THE LAST NON-ZERO    *
*     VALUE ON THE LAST CARD MUST BE PRECEDED BY A NEGATIVE      *
*     SIGN.                                                      *
*                                                                *
*  3. ... KLUES( 1) =  1 FIXED VARIABLE.                         *
*     .                                                          *
*     .   KLUES( 2) =  0 DO NOT LIST INTERMEDIATE OUTPUT IN      *
*     .                  THE INITIAL PHASE.                      *
*     .             =  2 LIST INTERMEDIATE OUTPUT IN THE         *
*     .                  INITIAL PHASE.                          *
*     .                                                          *
*     .   KLUES( 3) =  0 FIXED VARIABLE, EQUAL TO ZERO.          *
*     .                                                          *
*     .   KLUES( 4) =  0 DO NOT LIST ELEMENT CORNER FORCES       *
*     .                  AND MOMENTS FOR EACH ANALYSIS           *
*     .                  CYCLE.                                  *
*     .             =  4 LIST ELEMENT CORNER FORCES AND          *
*     .                  MOMENTS FOR EACH ANALYSIS CYCLE.        *
*     .                                                          *
*     .   KLUES( 5) =  0 DO NOT LIST NODAL DEFLECTIONS FOR       *
```

```
 ITEM        DATA                 DESCRIPTION
 ----        ----                 -----------

*      .                          EACH ANALYSIS CYCLE.                         *
*      .                   =  5 LIST NODAL DEFLECTIONS FOR EACH                *
*      .                          ANALYSIS CYCLE.                              *
*      .                                                                       *
*      .     KLUES( 6) =   0 DO NOT LIST MATRIX NAME,                          *
*      .                          INPUT/OUTPUT UNIT NUMBERS, FILE              *
*      .                          NUMBERS, AND MATRIX SIZE FOR MOST            *
*      .                          OF THE IMPORTANT MATRICES.                   *
*      .                   =  6 LIST MATRIX NAME, INPUT/OUTPUT UNIT            *
*      .                          NUMBERS, FILE NUMBERS, AND MATRIX            *
*      .                          SIZE FOR MOST OF THE IMPORTANT               *
*      .                          MATRICES.                                    *
*      .                                                                       *
*      .     KLUES( 7) =   0 DO NOT SAVE THE STRUCTURAL                        *
*      .                          STIFFNESS MATRIX FOR USE IN                  *
*      .                          VIBRATION ANALYSIS.                          *
*      .                   =  7 SAVE THE STRUCTURAL STIFFNESS                  *
*      .                          MATRIX FOR USE IN VIBRATION                  *
*      .                          ANALYSIS.                                    *
*      .                                                                       *
*      .     KLUES( 8) =   0 DO NOT SAVE THE FLEXIBILITY MATRIX                *
*      .                          FOR USE IN VIBRATION ANALYSIS.               *
*      .                   =  8 SAVE THE FLEXIBILITY MATRIX FOR USE            *
*      .                          IN VIBRATION ANALYSIS.                       *
*      .                                                                       *
*      .     KLUES( 9) =   0 IN CURRENT RUN, LOADS ARE NOT                     *
*      .                          AVAILABLE FROM CARDS.                        *
*      .                   =  9 IN CURRENT RUN, LOADS ARE AVAILABLE            *
*      .                          FROM CARDS.                                  *
*      .                          (IN CURRENT VERSION OF PROGRAM AT            *
*      .                          LEAST ONE DUMMY LOAD CASE MUST BE            *
*      .                          ENTERED ON CARDS IF KLUES(13) =              *
*      .                          13.)                                         *
*      .                                                                       *
*      .     KLUES(10) =   0 DO NOT INPUT LOAD CASES FROM ALAM.                *
*      .                   = 10 INPUT LOAD CASES FROM ALAM.                    *
*      .                                                                       *
*      .     KLUES(11) =   0 DO NOT LIST APPLIED COMBINED LOADS                *
*      .                          (FROM ALAM AND CARDS) AND/OR                 *
*      .                          FLEXIBILITY MATRIX.                          *
*      .                   = 11 LIST APPLIED COMBINED LOADS (FROM              *
*      .                          ALAM AND CARDS) AND/OR FLEXIBILITY           *
*      .                          MATRIX.                                      *
*      .                                                                       *
*      .     KLUES(12) =   0 DO NOT LIST THE FORCE BEAMING                     *
*      .                          TRANSFORMATION MATRIX FROM THE               *
*      .                          DYNAMICS GRID TO THE STRUCTURES              *
*      .                          GRID INCLUDING BOUNDARY CONDITIONS.          *
*      .                   = 12 LIST THE TRANSFORMATION MATRIX FROM            *
*      .                          THE DYNAMICS GRID TO THE STRUCTURES          *
*      .                          GRID INCLUDING BOUNDARY CONDITIONS.          *
```

```
 ITEM       DATA                DESCRIPTION
 ----       ----                -----------

*       .   KLUES(13) =   0 PERFORM STRENGTH ANALYSIS/REDESIGN      *
*       .                   BEFORE SAVING STIFFNESS OR              *
*       .                   FLEXIBILITY MATRICES FOR VIBRATION      *
*       .                   ANALYSIS.                               *
*       .             = 13 EXECUTE ONLY THAT PART OF STRENGTH       *
*       .                   ANALYSIS PROGRAM WHICH GENERATES        *
*       .                   THE STIFFNESS OR FLEXIBILITY MATRIX     *
*       .                   FOR USE IN VIBRATION ANALYSIS.          *
*       .                                                           *
*       .   KLUES(14) = 0   DO NOT SAVE THE ELEMENT STIFFNESS       *
*       .                   MATRIX.                                 *
*       .             = 14 SAVE THE ELEMENT STIFFNESS MATRIX.       *
*       .                    LET KLUES(14) = 14 IF KLUES(7) = 7     *
*       .                   OR KLUES(8) = 8.                        *
*       .                                                           *
*       .   KLUES(15) = 0   DO NOT SAVE THE OUTPUT MEMBER           *
*       .                   MATRIX.                                 *
*       .             = 15 SAVE THE OUTPUT MEMBER MATRIX.  LET      *
*       .                   KLUES(15) = 15 IF KLUES(7) = 7 OR       *
*       .                   KLUES(8) = 8.                           *
*       .                                                           *
*       .   KLUES(16) = 0   DO NOT SAVE THE STRUCTURAL              *
*       .                   DISPLACEMENT/DYNAMIC LOAD               *
*       .                   TRANSFORMATION MATRIX.                  *
*       .             = 16 SAVE THIS MATRIX.  LET KLUES(16) =       *
*       .                   16 IF KLUES(8) = 8.                     *
*       .                                                           *
*       .   KLUES(17) = 0   INITIAL PASS THROUGH THE STRUCTURAL     *
*       .                   OPTIMIZATION PROGRAM (SOP).             *
*       .             = 17 SECOND OR SUBSEQUENT PASS THROUGH        *
*       .                   THE STRUCTURAL OPTIMIZATION PROGRAM     *
*       .                   (SOP).                                  *
*       .                                                           *
*       .   KLUES(18) = 0   DATA IS NOT BEING PASSED FROM FOP       *
*       .                   TO SOP IN THIS RUN.  LET KLUES(18)      *
*       .                   = 0 IF KLUES(17) = 0.                   *
*       .             = 18 DATA IS BEING PASSED FROM FOP TO         *
*       .                   SOP IN THIS RUN.                        *
*       .                                                           *
*       .                   CLUES 19 - 25 SHOULD BE OMITTED IF      *
*       .                   KLUE(26) = 0.                           *
*       .                                                           *
*       .   KLUES(19) =   0 ANTISYMMETRIC FREE FREE VIBRATION       *
*       .                   MODES TO BE COMPUTED IN AVAM. ENTER     *
*       .                   KLUES(20) TO KLUES(22) AND OMIT         *
*       .                   KLUES(23) TO KLUES(25)                  *
*       .             = 19 SYMMETRIC FREE FREE VIBRATION MODES      *
*       .                   TO BE COMPUTED IN AVAM. OMIT            *
*       .                   KLUES(20) TO KLUES(22) AND ENTER        *
*       .                   KLUES(23) TO KLUES(25)                  *
*       .                                                           *
*       .   KLUES(20) =   0 IGNORE RIGID BODY LATERAL               *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*     .                      TRANSLATION.                              *
*     .               = 20  INCLUDE LATERAL TRANSLATION.              *
*     .                                                                *
*     .   KLUES(21) =   0  IGNORE RIGID BODY ROLL.                    *
*     .               = 21  INCLUDE ROLL.                              *
*     .                                                                *
*     .   KLUES(22) =   0  IGNORE RIGID BODY YAW.                     *
*     .               = 22  INCLUDE YAW.                               *
*     .                                                                *
*     .   KLUES(23) =   0  IGNORE RIGID BODY FORE-AFT                 *
*     .                      TRANSLATION.                              *
*     .               = 23  INCLUDE FORE-AFT TRANSLATION.             *
*     .                                                                *
*     .   KLUES(24) =   0  IGNORE RIGID BODY VERTICAL                 *
*     .                      TRANSLATION.                              *
*     .               = 24  INCLUDE VERTICAL TRANSLATION.             *
*     .                                                                *
*     .   KLUES(25) =   0  IGNORE RIGID BODY PITCH.                   *
*     ...             = 25  INCLUDE PITCH.                             *
*                                                                      *
*     FORMAT = (10I4).  NUMBER OF CARDS IS THREE OR LESS              *
*     DEPENDING UPON THE CONTROL WORD OPTIONS ENTERED AS DATA.        *
*     NOTE THAT THE LAST CARD CONTAINS THE LAST OPTION WHICH          *
*     IS INDICATED BY A NEGATIVE NUMBER.                              *
*                                                                      *
*     DATA ARE ENTERED BY THE SUBROUTINE ASAM THROUGH THE             *
*     SUBROUTINE CLUES.                                               *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*  4. ... NUMEMB(I)         NAME OF NEW MEMBER MATRIX                 *
*     .                     CONSISTING OF TWO WORDS OF FOUR           *
*     .                     CHARACTERS EACH. SUGGESTED NAME IS        *
*     ...                   SOPMEMBS.                                 *
*                                                                      *
*     ---------------------                                            *
*     000000000111111111|                                              *
*     123456789012345678|9                                             *
*     ---------------------                                            *
*     SOPMEMBS| NUMEMB(I)|                                             *
*     ---------------------                                            *
*                                                                      *
*     FORMAT = (2A4).  NUMBER OF CARDS IS 1.                          *
*                                                                      *
*     DATA ARE ENTERED BY SUBROUTINE DATASA.                          *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*  5. ... MAXAN             MAXIMUM NUMBER OF STRUCTURAL              *
*     .                     REDESIGN CYCLES TO BE PERMITTED           *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     .                      (STRESS CONSTRAINT).                  *
*     .                      IF THIS ITEM IS LEFT BLANK, THE       *
*     .                      PROGRAM WILL PERFORM A STRUCTURAL     *
*     .                      ANALYSIS, PRINTING OUT DEFLECTIONS,   *
*     .                      STRESSES, AND OTHER INTERMEDIATE      *
*     .                      OUTPUT THE USER MAY REQUIRE.  NO      *
*     .                      RESIZING OF MEMBERS WILL TAKE         *
*     .                      PLACE. IF KLUE(6) = 0 IN SOP LET      *
*     .                      MAXAN = 0.                            *
*     .                                                            *
*     .   MAXAN1 = 0         FIXED VARIABLE, EQUAL TO ZERO.        *
*     .                                                            *
*     .   NLC ≦ 8            TOTAL NUMBER OF LOAD CONDITIONS       *
*     .                      FROM ALAM AND FROM CARD DATA          *
*     .                      ENTERED IN THIS MODULE.               *
*     .                      AT LEAST ONE DUMMY LOAD CONDITION     *
*     .                      MUST BE ENTERED ON CARDS IF           *
*     ...                    KLUES(13) = 13.                       *
*                                                                  *
*     FORMAT = (3I4).  NUMBER OF CARDS IS 1.                       *
*                                                                  *
*     DATA ARE ENTERED BY SUBROUTINE DATASA.                       *
*                                                                  *
********************************************************************
*                                                                  *
*  6. ... LOGIC ITEM            *** NO DATA ***                    *
*                                                                  *
*     IF LOAD CONDITIONS ARE INCLUDED (NLC GREATER THAN ZERO)      *
*     ENTER DATA FOR THE FOLLOWING FOUR ITEMS, OTHERWISE (NLC      *
*     EQUAL TO ZERO) OMIT THESE ITEMS.                             *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*  7. ... CONCR              CONVERGENCE CRITERION FOR WEIGHT      *
*     .                      DIFFERENCES.                          *
*     .                      IF THE CHANGE, FROM ONE CYCLE TO      *
*     .                      THE NEXT, IN THE STRUCTURE'S TOTAL    *
*     .                      WEIGHT IS EQUAL TO OR LESS THAN THE   *
*     .                      CONVERGENCE CRITERION, THAT PHASE     *
*     .                      OF THE PROGRAM WILL BE TERMINATED.    *
*     .                                                            *
*     .   CONCR1             FIXED VARIABLE, LEAVE BLANK.          *
*     .                                                            *
*     .   SCFAC              FIXED VARIABLE, LEAVE BLANK.          *
*     .                                                            *
*     ... SFMIN              FIXED VARIABLE, LEAVE BLANK.          *
*                                                                  *
*     FORMAT = (4F5.0).  NUMBER OF CARDS IS 1.                     *
*                                                                  *
*     DATA ARE ENTERED BY SUBROUTINE DATASA.                       *
```

```
 ITEM       DATA              DESCRIPTION
 ----       ----              -----------

*****************************************************************
*                                                               *
*                                                               *
*     WHEN BLANK CARDS ARE ENTERED FOR THE FOLLOWING THREE      *
*     ITEMS, A DEFAULT VALUE OF UNITY WILL BE USED FOR ALL      *
*     REDUCTION FACTORS.                                        *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*     ENTER (EIGHT VALUES OR LESS PER CARD) AND                 *
*     REPEAT THE FOLLOWING ITEM FOR I= 1,....,NLC.              *
*                                                               *
*  8. ... TENS(I)          ALLOWABLE TENSION REDUCTION FACTOR   *
*     ...                  FOR THE I'TH LOAD CONDITION.         *
*                                                               *
*     FORMAT = (8F4.0).    NUMBER OF CARDS IS 1.                *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE DATASA.                    *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*     ENTER (EIGHT VALUES OR LESS PER CARD) AND                 *
*     REPEAT THE FOLLOWING ITEM FOR I= 1,....,NLC.              *
*                                                               *
*  9. ... COMP(I)          ALLOWABLE COMPRESSION REDUCTION      *
*     ...                  FACTOR FOR THE I'TH LOAD CONDITION.  *
*                                                               *
*     FORMAT = (8F4.0).    NUMBER OF CARDS IS 1.                *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE DATASA.                    *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*     ENTER (EIGHT VALUES OR LESS PER CARD) AND                 *
*     REPEAT THE FOLLOWING ITEM FOR I= 1,....,NLC.              *
*                                                               *
* 10. ... SHEAR(I)         ALLOWABLE SHEAR REDUCTION FACTOR     *
*     ...                  FOR THE I'TH LOAD CONDITION.         *
*                                                               *
*     FORMAT = (8F4.0).    NUMBER OF CARDS IS 1.                *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE DATASA.                    *
*                                                               *
*****************************************************************
*                                                               *
* 11. ... LOGIC ITEM            *** NO DATA ***                 *
*                                                               *
*     IF KLUES(17) = 17, THIS IS THE SECOND OR SUBSEQUENT PASS  *
*     THROUGH SOP AND ALL DATA ITEMS FROM THE FOLLOWING ITEM    *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     TO THE END OF SOP ARE OMITTED.  AT THE END, THE SINGLE        *
*     DATA CARD OF ITEM 38 INDICATING LABEL(0),ENDSARUN IS THE      *
*     LAST CARD.                                                    *
*                                                                   *
*********************************************************************
*                                                                   *
* 12. ... COMMENT             *** NO DATA ***                       *
*                                                                   *
*                                                                   *
*     A LABEL CARD, DESCRIBED PREVIOUSLY IN THE 'PROGRAM            *
*     APPLICATIONS SECTION', MUST PRECEDE EACH OF THE NINE          *
*     POSSIBLE DATA BLOCKS THE USER MAY WISH TO ENTER.  THE         *
*     FORMAT OF THE LABEL CARD AND THE FORMAT OF EACH DATA          *
*     BLOCK IS DESCRIBED IN THE FOLLOWING PAGES.  NOTE THAT         *
*     THE PROGRAM WILL CONTINUE TO READ ADDITIONAL DATA BLOCKS      *
*     UNTIL IT ENCOUNTERS A ZERO LABEL CARD                         *
*                                                                   *
*     LABEL CARDS AND CORRESPONDING DATA BLOCKS SHOULD BE           *
*     ENTERED IN THE ORDER IN WHICH THEY ARE DESCRIBED IN THIS      *
*     MANUAL, EVEN THOUGH LABEL NUMBERS WILL NOT BE IN              *
*     SEQUENCE .                                                    *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
*     B.  NODAL GEOMETRY COORDINATES AND BOUNDARY                   *
*     -------------------------------------------                   *
*         CONDITIONS                                                *
*         ----------                                                *
*                                                                   *
*                                                                   *
*     1.  GEOMETRY COORDINATES AND BOUNDARY CONDITIONS              *
*     ------------------------------------------------              *
*                                                                   *
*********************************************************************
*                                                                   *
* 13. ... LABEL CARD         SPECIFIC FORMAT OF THIS DATA ITEM      *
*     .                      IS GIVEN BELOW INCLUDING SUGGESTED     *
*     .                      NAMES FOR THE PSEUDO MATRICES BEING    *
*     ...                    GENERATED.                             *
*                                                                   *
*     --------------------------------------------------            *
*     |00000000011111111112222222222333333333344444444445           *
*     |12345678901234567890123456789012345678901234567890           *
*     |--------------------------------------------------           *
*     |SA01 LABEL(1),GEOMETRY,BOUNCOND                   |          *
*     --------------------------------------------------            *
*                                                                   *
*     FORMAT = (5X, A4, 2X, I1, 2X, A8, 1X, A8). NUMBER OF          *
*     CARDS IS 1.                                                   *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.               *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

***********************************************************************
*                                                                     *
*     NOTE THAT FOR CORRECT OPERATION OF THE AUTOMATED                *
*     TRANSFORMATION ANALYSIS MODULE (ATAM), NODE NUMBERING           *
*     SHOULD BE SUCH THAT A LOWER COVER NODE NUMBER IS                *
*     INCREMENTED BY +1 WITH RESPECT TO THE ADJACENT UPPER            *
*     COVER NODE NUMBER.  ALL UPPER COVER NODES SHOULD HAVE           *
*     ODD NUMBERS.                                                    *
*                                                                     *
*                                                                     *
*     THE BOUNDARY CONDITIONS FOR THE TYPICAL NODAL DEGREES OF        *
*     FREEDOM ARE SPECIFIED BELOW.  PROVIDE EITHER A ZERO (OR         *
*     BLANK) FOR A FIXED DEGREE OF FREEDOM OR A ONE FOR A FREE        *
*     DEGREE OF FREEDOM. A VALUE OF TWO INSTEAD OF ZERO WILL          *
*     PROVIDE A SEQUENTIAL NEGATIVE COUNT OF THE FIXED DEGREES        *
*     OF FREEDOM IN THE LISTING FOR THE GEOMETRY AND BOUNDARY         *
*     CONDITIONS.                                                     *
*                                                                     *
*                                                                     *
*     REPEAT THE FOLLOWING ITEM                                       *
*     UNTIL A BLANK CARD IS ENCOUNTERED                               *
*                                                                     *
* 14. ... I                 NODE NUMBER.                              *
*     .                                                               *
*     .   XX                X GLOBAL COORDINATE FOR THE I'TH          *
*     .                     NODE NUMBER, POSITIVE AFT, IN.            *
*     .                                                               *
*     .   YY                Y GLOBAL COORDINATE FOR THE I'TH          *
*     .                     NODE NUMBER, POSITIVE TO THE LEFT,        *
*     .                     IN                                        *
*     .                                                               *
*     .   ZZ                Z GLOBAL COORDINATE FOR THE I'TH          *
*     .                     NODE NUMBER, POSITIVE UP, IN.             *
*     .                                                               *
*     .                     FOR THE FOLLOWING SIX BOUNDARY            *
*     .                     CONDITIONS PROVIDE EITHER A  ZERO         *
*     .                     (OR BLANK) FOR A FIXED DEGREE OF          *
*     .                     FREEDOM OR A ONE FOR A FREE DEGREE        *
*     .                     OF FREEDOM.                               *
*     .                                                               *
*     .   IIBC(1)           BOUNDARY CONDITION FOR THE DEGREE         *
*     .                     OF FREEDOM ALONG THE X AXIS.              *
*     .                                                               *
*     .   IIBC(2)           BOUNDARY CONDITION FOR THE DEGREE         *
*     .                     OF FREEDOM ALONG THE Y AXIS.              *
*     .                                                               *
*     .   IIBC(3)           BOUNDARY CONDITION FOR THE DEGREE         *
*     .                     OF FREEDOM ALONG THE Z AXIS.              *
*     .                                                               *
*     .   IIBC(4)           BOUNDARY CONDITION FOR THE DEGREE         *
*     .                     OF FREEDOM ABOUT THE X AXIS.              *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*      .   IIBC(5)          BOUNDARY CONDITION FOR THE DEGREE      *
*      .                    OF FREEDOM ABOUT THE Y AXIS.           *
*      .                                                           *
*      .   IIBC(6)          BOUNDARY CONDITION FOR THE DEGREE      *
*      ...                  OF FREEDOM ABOUT THE Z AXIS.           *
*                                                                  *
*      FORMAT = (I4,3E13.6,10X,6I1).  NUMBER OF CARDS IS           *
*      DEFINED BY A BLANK CARD AT THE END OF THIS DATA BLOCK.      *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE GEOBC.                       *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*      2.  GEOMETRY COORDINATES ONLY.                              *
*      ------------------------------                              *
*                                                                  *
********************************************************************
*                                                                  *
* 15.  ... LABEL CARD       SPECIFIC FORMAT OF THIS DATA ITEM      *
*      .                    IS GIVEN BELOW INCLUDING SUGGESTED     *
*      .                    NAMES FOR THE PSEUDO MATRICES BEING    *
*      ...                  GENERATED.                             *
*                                                                  *
*      --------------------------------------------------          *
*      |00000000011111111112222222222333333333344444444445|        *
*      |12345678901234567890123456789012345678901234567890|        *
*      |--------------------------------------------------|        *
*      |SA02 LABEL(2),GEOMETRY                            |        *
*      --------------------------------------------------          *
*                                                                  *
*      FORMAT = (5X, A4, 2X, I1, 2X, A8). NUMBER OF CARDS IS 1.    *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.             *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
* 16.  ... GEOMETRY         THE FORMAT TO READ THE GEOMETRY IS     *
*      .                    THE SAME AS ITEM 14, WHERE IN THIS     *
*      .                    CASE THE PROGRAM MAKES USE OF THE      *
*      ...                  GEOMETRY ONLY.                         *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*      3.  BOUNDARY CONDITIONS ONLY                                *
*      ----------------------------                                *
*                                                                  *
********************************************************************
*                                                                  *
* 17.  ... LABEL CARD       SPECIFIC FORMAT OF THIS DATA ITEM      *
```

```
 ITEM      DATA                DESCRIPTION
 ----      ----                -----------

*       .                      IS GIVEN BELOW INCLUDING SUGGESTED     *
*       .                      NAMES FOR THE PSEUDO MATRICES BEING    *
*       ...                    GENERATED.                             *
*                                                                     *
*      -------------------------------------------------              *
*      |00000000011111111112222222222333333333344444444445|           *
*      |12345678901234567890123456789012345678901234567890|           *
*      ---------------------------------------------------            *
*      |SA03 LABEL(3),BCUNCOND                            |           *
*      ---------------------------------------------------            *
*                                                                     *
*      FORMAT = (5X, A4, 2X, I1, 2X, A8). NUMBER OF CARDS IS 1.       *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.                *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
* 18.  ... B. C.'S             THE FORMAT TO READ THE BOUNDARY        *
*       .                      CONDITIONS IS THE SAME AS ITEM 14,     *
*       .                      WHERE IN THIS CASE THE PROGRAM         *
*       .                      MAKES USE OF THE BOUNDARY              *
*       ...                    CONDITICNS ONLY.                       *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*      4.  CONDENSED BCUNDARY CONDITICNS                              *
*      ---------------------------------                              *
*                                                                     *
***********************************************************************
*                                                                     *
* 19.  ... LABEL CARD          SPECIFIC FORMAT OF THIS DATA ITEM      *
*       .                      IS GIVEN BELOW INCLUDING SUGGESTED     *
*       .                      NAMES FOR THE PSEUDO MATRICES BEING    *
*       ...                    GENERATED.                             *
*                                                                     *
*      ---------------------------------------------------            *
*      |00000000011111111112222222222333333333344444444445|           *
*      |12345678901234567890123456789012345678901234567890|           *
*      ---------------------------------------------------            *
*      |SA07 LABEL(7),BCUNCOND                            |           *
*      ---------------------------------------------------            *
*                                                                     *
*      FORMAT = (5X, A4, 2X, I1, 2X, A8). NUMBER OF CARDS IS 1.       *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.                *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*      THE BCUNDARY CONDITIONS FCF THE TYPICAL NODAL DEGREES OF       *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*     FREEDOM ARE SPECIFIED BELOW.  PROVIDE EITHER A ZERO (OR       *
*     BLANK) FOR A FIXED DEGREE OF FREEDOM OR A ONE FOR A FREE      *
*     DEGREE OF FREEDOM. A VALUE OF TWO INSTEAD OF ZERO WILL        *
*     PROVIDE A SEQUENTIAL NEGATIVE COUNT OF THE FIXED DEGREES      *
*     OF FREEDOM IN THE LISTING FOR THE GEOMETRY AND BOUNDARY       *
*     CONDITIONS.                                                   *
*                                                                   *
* 20. ... IIBC(1)           BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ALONG THE X AXIS.            *
*       .                                                           *
*       .   IIBC(2)         BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ALONG THE Y AXIS.            *
*       .                                                           *
*       .   IIBC(3)         BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ALONG THE Z AXIS.            *
*       .                                                           *
*       .   IIBC(4)         BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ABOUT THE X AXIS.            *
*       .                                                           *
*       .   IIBC(5)         BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ABOUT THE Y AXIS.            *
*       .                                                           *
*       .   IIBC(6)         BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ABOUT THE Z AXIS.            *
*       .                                                           *
*       .   JOINTS          TOTAL NUMBER OF NODES IN THE            *
*     ...                   STRUCTURE.                              *
*                                                                   *
*     FORMAT = (6I1,I4).  NUMBER OF CARDS IS 1.                     *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE BOUND.                         *
*                                                                   *
*********************************************************************
*                                                                   *
*     THE BOUNDARY CONDITIONS FOR THE EXCEPTIONS TO THE NODAL       *
*     DEGREES OF FREEDOM ARE SPECIFIED BELOW.  PROVIDE EITHER       *
*     A ZERO (OR BLANK) FOR A FIXED DEGREE OF FREEDOM OR A ONE      *
*     FOR A FREE DEGREE OF FREEDOM. A VALUE OF TWO INSTEAD OF       *
*     ZERO WILL PROVIDE A SEQUENTIAL NEGATIVE COUNT OF THE          *
*     FIXED DEGREES OF FREEDOM IN THE LISTING FOR THE GEOMETRY      *
*     AND BOUNDARY CONDITIONS.                                      *
*                                                                   *
*                                                                   *
*     REPEAT THE FOLLOWING ITEM                                     *
*     UNTIL A BLANK CARD IS ENCOUNTERED                             *
*                                                                   *
* 21. ... IIBC(1)           BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ALONG THE X AXIS.            *
*       .                                                           *
*       .   IIBC(2)         BOUNDARY CONDITION FOR THE DEGREE       *
*       .                   OF FREEDOM ALONG THE Y AXIS.            *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*      .   IIBC(3)          BOUNDARY CONDITION FOR THE DEGREE      *
*      .                    OF FREEDOM ALONG THE Z AXIS.           *
*      .                                                           *
*      .   IIBC(4)          BOUNDARY CONDITION FOR THE DEGREE      *
*      .                    OF FREEDOM ABOUT THE X AXIS.           *
*      .                                                           *
*      .   IIBC(5)          BOUNDARY CONDITION FOR THE DEGREE      *
*      .                    OF FREEDOM ABOUT THE Y AXIS.           *
*      .                                                           *
*      .   IIBC(6)          BOUNDARY CONDITION FOR THE DEGREE      *
*      .                    OF FREEDOM ABOUT THE Z AXIS.           *
*      .                                                           *
*      .                    ENTER (TWELVE VALUES OR LESS PER       *
*      .                    CARD)                                  *
*      .                    FOR THE FOLLOWING VARIABLE.            *
*      .                                                           *
*      .   JT(J), J=1,12    EXCEPTION TO THE NODAL DEGREE OF       *
*      .                    FREEDOM FOR THE JT(J)'TH NODE.  A      *
*      .                    NEGATIVE VALUE FOR JT(J) INDICATES     *
*      .                    THAT THE BOUNDARY CONDITION            *
*      .                    EXCEPTIONS INDICATED ON THIS CARD      *
*      .                    APPLY FROM JT(J-1) TO JT(J) RANGE      *
*      ...                  OF NODES.  (SEE FIGURE 2.)             *
*                                                                  *
*      FORMAT = (6I1,4X,12I5).  NUMBER OF CARDS IS DEFINED BY A    *
*      BLANK CARD AT THE END OF THIS DATA BLOCK.                   *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE BOUND.                       *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*      C.  MATERIAL PROPERTIES UPDATE                              *
*      ------------------------------                              *
*                                                                  *
********************************************************************
*                                                                  *
* 22.  ... LABEL CARD       SPECIFIC FORMAT OF THIS DATA ITEM      *
*      .                    IS GIVEN BELOW INCLUDING SUGGESTED     *
*      .                    NAMES FOR THE PSEUDO MATRICES BEING    *
*      ...                  GENERATED.                             *
*                                                                  *
*     ---------------------------------------------------          *
*     |00000000011111111112222222222333333333344444444445|         *
*     |12345678901234567890123456789012345678901234567890|         *
*     |--------------------------------------------------|         *
*     |SA04 LABEL(4),MATERIAL                            |         *
*     ---------------------------------------------------          *
*                                                                  *
*      FORMAT = (5X, A4, 2X, I1, 2X, A8). NUMBER OF CARDS IS 1.    *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.             *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*******************************************************************
*                                                                 *
*     THREE SETS OF MATERIAL PROPERTIES (MATERIAL CODE (I), I     *
*     = 1,3) ARE STORED WITHIN THE PROGRAM (SEE FIGURE 4).        *
*                                                                 *
*     ITEM 23 ALLOWS THE USER TO SPECIFY DATA FOR UP TO 17        *
*     ADDITIONAL MATERIALS (MATERIAL CODE (I), I = 4,20).         *
*      ITEM 24 ALLOWS THE USER TO SPECIFY MINIMUM AND/OR          *
*     MAXIMUM SIZES FOR MEMBERS MADE OF EACH PARTICULAR           *
*     MATERIAL (MATERIAL CODE (I), I= 1,20). SEE FIGURE 5.        *
*                                                                 *
*     REPEAT THE FOLLOWING TWO ITEMS                              *
*     (IF BOTH ARE DESIRED) FOR EACH MATERIAL                     *
*     UNTIL A BLANK CARD IS ENCOUNTERED.                          *
*                                                                 *
*                                                                 *
*     1.  MATERIAL CODE AND ASSOCIATED PARAMETERS.                *
*     --------------------------------------------                *
*                                                                 *
* 23. ... I                 MATERIAL CODE. I = 4,....,20. (CODES  *
*      .                    1-3 ARE PRESET.)                      *
*      .                                                          *
*      .  TNS               TENSION ALLOWABLE STRESS, LB/IN**2.   *
*      .                                                          *
*      .  CMP               COMPRESSION ALLOWABLE STRESS,         *
*      .                    LB/IN**2.                             *
*      .                                                          *
*      .  SHR               SHEAR ALLOWABLE STRESS, LB/IN**2.     *
*      .                                                          *
*      .  YM                ELASTIC MODULUS, LB/IN**2.            *
*      .                                                          *
*      .  BNU               POISSON'S RATIO.                      *
*      .                                                          *
*      .  RHO               DENSITY, LB/IN**3                     *
*      .                                                          *
*      .  MATR(I)           MATERIAL IDENTITY CONSISTING OF       *
*     ...                   SIXTEEN OR LESS CHARACTERS.           *
*                                                                 *
*     FORMAT = (5X,I3,6F8.0,4A4). NUMBER OF CARDS IS 1 FOR        *
*     EACH MATERIAL CODE.                                         *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE MEMBIN THROUGH THE ENTRY     *
*     POINT MATRAL.                                               *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*     2.  MATERIAL CODE AND MAXIMUM AND MINIMUM MEMBER SIZES      *
*     ------------------------------------------------------      *
*                                                                 *
* 24. ... J = I + 100     MATERIAL CODE (I) + 100                 *
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

*      .   AMIN               MINIMUM SIZE OF ANY MEMBER ASSIGNED     *
*      .                      MATERIAL CODE I.  IN.                   *
*      .                                                              *
*      .   AMAX               MAXIMUM SIZE OF ANY MEMBER ASSIGNED     *
*      ...                    MATERIAL CODE I.  IN.                   *
*                                                                     *
*      FORMAT = (5X,I3,2F8.0).  NUMBER OF CARDS IS DEFINED BY A       *
*      BLANK CARD AT THE END OF THIS DATA BLOCK.                      *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE MEMBIN THROUGH THE ENTRY        *
*      POINT MATRAL.                                                  *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*      D.  LOAD CONDITIONS                                            *
*      -------------------                                            *
*                                                                     *
***********************************************************************
*                                                                     *
* 25.  ... LABEL CARD         SPECIFIC FORMAT OF THIS DATA ITEM       *
*      .                      IS GIVEN BELOW INCLUDING SUGGESTED      *
*      .                      NAMES FOR THE PSEUDO MATRICES BEING     *
*      .                      GENERATED. NOTE THAT THE TOTAL          *
*      .                      NUMBER OF LOAD CONDITIONS ENTERED       *
*      .                      ON CARDS IN THE FOLLOWING ITEM MUST     *
*      .                      BE INCLUDED WITHIN THE PARENTHESIS      *
*      ...                    IN SA LOADS( ).                         *
*                                                                     *
*      --------------------------------------------------             *
*      |00000000011111111112222222222333333333344444444445|           *
*      |12345678901234567890123456789012345678901234567890|           *
*      |--------------------------------------------------|           *
*      |SA06 LABEL(6).SA LOADS( )                         |           *
*      --------------------------------------------------             *
*                                                                     *
*      FORMAT = (5X, A4, 2X, I1, 2X, A8, 1X, I1). NUMBER OF           *
*      CARDS IS 1.                                                    *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.                *
*                                                                     *
***********************************************************************
*                                                                     *
*      FOR TYPICAL INPUT, SEE FIGURES 6 AND 7.                        *
*                                                                     *
*      ENTER (THREE GROUPS PER CARD)                                  *
*      FOR THE FOLLOWING ITEM FOR I = 1,...,3 AND                     *
*                                                                     *
*      REPEAT THE FOLLOWING ITEM                                      *
*      UNTIL A BLANK CARD IS ENCOUNTERED                              *
*                                                                     *
* 26.  ... LNODE(I)           NODE NUMBER.  ENTIRE BLOCK OF DATA      *
```

```
ITEM     DATA            DESCRIPTION
----     ----            -----------

*       .                MUST BE FILLED OUT IN ASCENDING          *
*       .                ORDER OF THE NODE NUMBERS.               *
*       .                                                         *
*       .  LCOMP(I)      FORCE AND MOMENT COMPONENTS.             *
*       .                 WITHIN A GIVEN NODE, THE                *
*       .                COMPONENTS MUST BE IN ASCENDING          *
*       .                ORDER, FX=1, FY=2, FZ=3, MX=4,           *
*       .                MY=5, AND/OR MZ=6.  NOTE THAT            *
*       .                EITHER THE LETTER OR NUMBER              *
*       .                DESIGNATIONS MAY BE USED.                *
*       .                                                         *
*       .  LCOND(I)≤ 8   CONDITION NUMBER.  WITHIN A GIVEN        *
*       .                NODE AND COMPONENT, THE CONDITION        *
*       .                NUMBERS (COLUMN NUMBERS) MUST BE IN      *
*       .                ASCENDING ORDER.                         *
*       .                                                         *
*       .  ELMT(I)       VALUE OF LOAD COMPONENT.  (FX -          *
*       .                POSITIVE AFT, FY - POSITIVE TO THE       *
*       .                LEFT, FZ - POSITIVE UP, MX -             *
*       .                POSITIVE RIGHT WING DOWN, MY -           *
*       .                POSITIVE NOSE UP, AND MZ - POSITIVE      *
*       ...              NOSE RIGHT).                             *
*                                                                 *
*       FORMAT = (3(I4,A2,I4,E14.7)).  NUMBER OF CARDS IS         *
*       DEFINED BY A BLANK CARD AT THE END OF THIS DATA BLOCK.    *
*                                                                 *
*       DATA ARE ENTERED BY SUBROUTINE LOADIN.                    *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*       E.  MEMBER PROPERTIES                                     *
*           -----------------                                     *
*                                                                 *
*******************************************************************
*                                                                 *
* 27.   ... LABEL CARD       SPECIFIC FORMAT OF THIS DATA ITEM    *
*       .                    IS GIVEN BELOW INCLUDING SUGGESTED   *
*       .                    NAMES FOR THE PSEUDO MATRICES BEING  *
*       ...                  GENERATED.                           *
*                                                                 *
*       --------------------------------------------------        *
*       |00000000011111111112222222222333333333344444444445       *
*       |12345678901234567890123456789012345678901234567890       *
*       --------------------------------------------------        *
*       |SA05 LABEL(5),MEMBPROP                          |        *
*       --------------------------------------------------        *
*                                                                 *
*       FORMAT = (5X, A4, 2X, I1, 2X, A8). NUMBER OF CARDS IS 1.  *
*                                                                 *
*       DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.           *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*****************************************************************
*                                                               *
*    DATA FOR THE MEMBER PROPERTIES IS ENTERED USING A          *
*    GENERAL PROCEDURE TO HANDLE A WIDE VARIETY OF              *
*    IDEALIZATIONS AND TYPES OF PROBLEMS.  IN THE FOLLOWING     *
*    ITEMS A MULTI-PURPOSE FORMAT IS USED TO ENTER DATA FROM    *
*    EACH CARD AND THEN DEPENDING UPON THE DATA CLASS THE       *
*    INFORMATION IS STORED IN THE APPROPRIATE VARIABLES FOR     *
*    THE THREE BASIC CATEGORIES DISCUSSED BELOW.                *
*                                                               *
*    NOTE THAT THE DATA CLASS CODE VARIES AS FOLLOWS.           *
*                                                               *
*       CLASS 1, TOPOLOGY AND GEOMETRIC PROPERTIES,             *
*       CLASS 2, ELASTIC PROPERTIES,                            *
*       CLASS 3, DATA FOR FUTURE USE,                           *
*       CLASS 4, DATA FOR FUTURE USE,                           *
*       CLASS 5, ALLOWABLE STRESSES AND PRESCRIBED SIZES.       *
*                                                               *
*                                                               *
*    TYPES OF MEMBER DATA WHICH THE PRESENT PROGRAM CAN         *
*    HANDLE ARE PRESENTED IN FIGURES 10 TO 18.                  *
*                                                               *
*    FOR CLASS CODE 1, ENTER DATA IN ITEMS 28 AND 29.           *
*    FOR CLASS CODE 2, ENTER DATA IN ITEMS 30 AND 31.           *
*    FOR CLASS CODE 5, ENTER DATA IN ITEM 33.                   *
*                                                               *
*    REPEAT THE FOLLOWING SIX ITEMS FOR                         *
*    EACH STRUCTURAL MEMBER                                     *
*    UNTIL A BLANK CARD IS ENCOUNTERED.                         *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*    1.  TOPOLOGY AND GEOMETRIC PROPERTIES                      *
*    -------------------------------------                      *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*    A.  CLASS 1 - SUBCLASS 1                                   *
*    ------------------------                                   *
*        (ISOTROPIC AND ORTHOTROPIC OR ANISOTROPIC)             *
*        ------------------------------------------             *
*                                                               *
* 28. ... MEMBER NUMBER  MEMBER NUMBER.  ENTERED ON EVERY       *
*     .                  CARD WHICH CONTAINS INFORMATION ON     *
*     .                  THE THREE BASIC CATEGORIES OF THE      *
*     .                  MEMBER PROPERTIES. THE MEMBER          *
*     .                  NUMBER IS ARBITRARY BUT THERE IS A     *
*     .                  LIMIT OF 3000 ELEMENTS.                *
*     .                                                         *
*     .   MEMBER TYPE    MEMBER TYPE AS DEFINED IN FIGURES      *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*      .                     10 TO 18. THE MAXIMUM VALUE IS          *
*      .                     SIXTEEN.                                *
*      .                                                             *
*      .   MATERIAL          MATERIAL CODE WHICH INDICATES THE       *
*      .                     TYPE OF MATERIAL AND ITS                *
*      .                     PROPERTIES. FIGURE 4 INDICATES THE      *
*      .                     PROGRAM BUILT-IN STANDARDS AND THE      *
*      .                     CAPABILITY FOR THE USER TO SPECIFY      *
*      .                     HIS OWN MATERIAL PROPERTIES.  A         *
*      .                     VALUE FROM ONE TO THREE PROVIDES        *
*      .                     THE BUILT-IN STANDARDS WHEREAS A        *
*      .                     VALUE FROM FOUR TO TWENTY PROVIDES      *
*      .                     THE USER SPECIFICATIONS. THE            *
*      .                     MAXIMUM VALUE IS TWENTY.                *
*      .                                                             *
*      .   CONSTRUCTION      CONSTRUCTION CODE USED TO SELECT        *
*      .                     STABILITY TABLES FOR THE MEMBER.        *
*      .                     ANY ONE OF TEN CONSTRUCTION CODES       *
*      .                     PROVIDED IN THE 'STABILITY              *
*      .                     CONDITIONS' SECTION. THE MAXIMUM        *
*      .                     VALUE IS TEN.                           *
*      .                                                             *
*      .   CLASS = 1         CLASS CODE IS ONE.                      *
*      .                                                             *
*      .   SUBCLASS = 1      SUBCLASS CODE IS ONE.                   *
*      .                                                             *
*      .                     ENTER (FOUR VALUES OR LESS PER          *
*      .                     CARD)                                   *
*      .                     FOR THE FOLLOWING VARIABLE.             *
*      .                                                             *
*      .   NODES(J)          NODE NUMBERS (J=1,4) TO WHICH A         *
*      .                     PARTICULAR MEMBER CONNECTS.             *
*      .                                                             *
*      .                     ENTER (FIVE VALUES OR LESS PER          *
*      .                     CARD)                                   *
*      .                     FOR THE FOLLOWING VARIABLE FOR          *
*      .                     J=1,5.                                  *
*      .                                                             *
*      .   BUFFER(J)         FURTHER GEOMETRIC PROPERTIES            *
*      .                     (J=1,5) OF THE MEMBERS SUMMARIZED       *
*      ...                   IN FIGURES 10 TO 18.                    *
*                                                                    *
*      FORMAT = (I4,2I2,4X,I2,2I1,4I4,5E8.0). NUMBER OF CARDS        *
*      IS 1 FOR EACH STRUCTURAL MEMBER.                              *
*                                                                    *
*      DATA ARE ENTERED BY THE SUBROUTINE MEMBIN.                    *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*      8.  CLASS 1 - SUBCLASS 2                                      *
*      ------------------------                                      *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*         (ISCTRCFIC AND ORTHCTRCPIC OR ANISOTROPIC)                  *
*         ------------------------------------------                  *
*                                                                     *
* 29. ... MEMBER DATA       MEMBER NUMBER.  ENTERED ON EVERY          *
*       .                   CARD WHICH CONTAINS INFORMATION ON        *
*       .                   THE THREE BASIC CATEGORIES OF THE         *
*       .                   MEMBER PROPERTIES. THE MEMBER             *
*       .                   NUMBER IS ARBITRARY BUT THERE IS A        *
*       .                   LIMIT OF 3000 ELEMENTS.                   *
*       .                                                             *
*       .  CLASS = 1        CLASS CCDE IS ONE.                        *
*       .                                                             *
*       .  SUBCLASS = 2     SUBCLASS CODE IS TWO.                     *
*       .                                                             *
*       .                   ENTER (FOUR VALUES OR LESS PER            *
*       .                   CARD)                                     *
*       .                   FOR THE FCLLOWING VARIABLE.               *
*       .                                                             *
*       .  NODES(J)         NODE NUMBERS (J=1,4) TO DEFINE            *
*       .                   'KICK' FORCE DIRECTIONS. (SEE             *
*       ...                 FIGURES 14 AND 15).                       *
*                                                                     *
*     FORMAT = (I4,10X,2I1,4I4). NUMBER OF CARDS IS 1 FOR EACH        *
*     STRUCTURAL MEMBER.                                              *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE MEMBIN.                          *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*     2.  ELASTIC PRCPERTIES                                          *
*     ----------------------                                          *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*     A.  CLASS 2 - SUBCLASS 1                                        *
*     ------------------------                                        *
*         (ISOTROPIC AND ORTHCTROPIC OR ANISOTROPIC)                  *
*         ------------------------------------------                  *
*                                                                     *
* 30. ... MEMBER NUMBER     MEMBER NUMBER.  ENTERED ON EVERY          *
*       .                   CARD WHICH CONTAINS INFORMATION ON        *
*       .                   THE THREE BASIC CATEGORIES OF THE         *
*       .                   MEMBER PROPERTIES. THE MEMBER             *
*       .                   NUMBER IS ARBITRARY BUT THERE IS A        *
*       .                   LIMIT OF 3000 ELEMENTS.                   *
*       .                                                             *
*       .  CLASS = 2        CLASS CCDE IS TWO.                        *
*       .                                                             *
*       .  SUBCLASS = 1     SUBCLASS CCDE IS ONE.                     *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*       .                    ENTER (FIVE VALUES OR LESS PER          *
*       .                    CARD)                                   *
*       .                    FOR THE FOLLOWING VARIABLE.             *
*       .                                                            *
*       .   BUFFER(J)        ELASTIC CONSTANTS (J=1,5).  FOR         *
*       .                    STANDARD ISOTROPIC ELASTIC ANALYSES     *
*       .                    THESE FACTORS NEED NOT BE SPECIFIED     *
*       .                    AS THE PROGRAM WILL COMPUTE THEM        *
*       .                    BASED ON THE MATERIAL CODE.  FOR        *
*       .                    ANISOTROPIC MEMBERS THESE FACTORS       *
*       .                    MUST CONTAIN THE SPECIFIC VALUES AS     *
*       ...                  INDICATED IN FIGURES 12 TO 18.          *
*                                                                    *
*       FORMAT = (I4,10X,2I1,16X,5E8.0). NUMBER OF CARDS IS 1        *
*       FOR EACH STRUCTURAL MEMBER.                                  *
*                                                                    *
*       DATA ARE ENTERED BY SUBROUTINE MEMBIN.                       *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*       8.  CLASS 2 - SUBCLASS 2 (ANISOTROPIC)                       *
*       -------------------------------------                        *
*                                                                    *
* 31.  ... MEMBER NUMBER     MEMBER NUMBER.  ENTERED ON EVERY        *
*       .                    CARD WHICH CONTAINS INFORMATION ON      *
*       .                    THE THREE BASIC CATEGORIES OF THE       *
*       .                    MEMBER PROPERTIES. THE MEMBER           *
*       .                    NUMBER IS ARBITRARY BUT THERE IS A      *
*       .                    LIMIT OF 3000 ELEMENTS.                 *
*       .                                                            *
*       .   CLASS = 2        CLASS CODE IS TWO.                      *
*       .                                                            *
*       .   SUBCLASS = 2     SUBCLASS CODE IS TWO.                   *
*       .                                                            *
*       .                    ENTER (FIVE VALUES OR LESS PER          *
*       .                    CARD)                                   *
*       .                    FOR THE FOLLOWING VARIABLE.             *
*       .                                                            *
*       .   BUFFER(J)        ELASTIC CONSTANTS (J=1,5). FOR          *
*       .                    ANISOTROPIC MEMBERS THESE FACTORS       *
*       .                    MUST CONTAIN THE SPECIFIC VALUES AS     *
*       ...                  INDICATED IN FIGURES 12 TO 18.          *
*                                                                    *
*       FORMAT = (I4,10X,2I1,16X,5E8.0). NUMBER OF CARDS IS 1        *
*       FOR EACH STRUCTURAL MEMBER.                                  *
*                                                                    *
*       DATA ARE ENTERED BY SUBROUTINE MEMBIN.                       *
*                                                                    *
**********************************************************************
```

```
 ITEM       DATA              DESCRIPTION
 ----       ----              -----------

*      3. AND 4.  DATA FOR FUTURE USE                              *
*      ----------------------------                                *
*                                                                  *
* 32. ... FUTURE USE      THIS CAPABILITY IS NOT AVAILABLE.        *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*      5.  ALLOWABLE STRESSES AND PRESCRIBED SIZES.                *
*      -------------------------------------------                 *
*          (CLASS 5 - SUBCLASS 1)                                  *
*          ----------------------                                  *
*                                                                  *
* 33. ... MEMBER NUMBER   MEMBER NUMBER.  ENTERED ON EVERY         *
*      .                  CARD WHICH CONTAINS INFORMATION ON       *
*      .                  THE THREE BASIC CATEGORIES OF THE        *
*      .                  MEMBER PROPERTIES. THE MEMBER            *
*      .                  NUMBER IS ARBITRARY BUT THERE IS A       *
*      .                  LIMIT OF 3000 ELEMENTS.                  *
*      .                                                           *
*      .   CLASS = 5      CLASS CODE IS FIVE.                      *
*      .                                                           *
*      .   SUBCLASS = 1   SUBCLASS CODE IS ONE.                    *
*      .                                                           *
*      .   BUFFER(1)      TENSION ALLOWABLE STRESS FOR THE         *
*      .                  MEMBER, LB/IN**2.                        *
*      .                                                           *
*      .   BUFFER(2)      COMPRESSION ALLOWABLE STRESS FOR         *
*      .                  THE MEMBER, LB/IN**2.                    *
*      .                                                           *
*      .   BUFFER(3)      SHEAR ALLOWABLE STRESS FOR THE           *
*      .                  MEMBER, LB/IN**2.                        *
*      .                                                           *
*      .   BUFFER(4)      MINIMUM SIZE.                            *
*      .                                                           *
*      .   BUFFER(5)      MAXIMUM SIZE.                            *
*      .                                                           *
*      .                  THE ABOVE FIVE VARIABLES ARE             *
*      .                  ENTERED ON ONE CARD, DATA CLASS 5-       *
*      .                  SUBCLASS 1. IF A 51 CARD IS NOT          *
*      .                  INPUT, THE PROGRAM WILL USE A SET        *
*      .                  OF BUILT-IN ALLOWABLES FOR               *
*      .                  ALUMINUM, TITANIUM, AND STEEL SHOWN      *
*      .                  IN FIGURE 4. IF THE USER DOES NOT        *
*      .                  PRESCRIBE SIZE LIMITATIONS, THE          *
*      .                  PROGRAM WILL SET A MINIMUM SIZE OF       *
*      ...                0.0001.                                  *
*                                                                  *
*      FORMAT = (I4,10X,2I1,16X,5E8.0). NUMBER OF CARDS IS         *
*      DEFINED BY A BLANK CARD AT THE END OF THE MEMBER DATA.      *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE MEMBIN.                      *
```

```
*****************************************************************
*                                                               *
*                                                               *
*     F.  DEFLECTION CONSTRAINT CONDITIONS                      *
*     ------------------------------------                      *
*                                                               *
*****************************************************************
*                                                               *
*     DOES NOT APPLY.                                           *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*     G.  STABILITY CONDITIONS                                  *
*     ------------------------                                  *
*     (SEE PROGRAM APPLICATION SECTION)                         *
*                                                               *
* 34. ... LABEL CARD       SPECIFIC FORMAT OF THIS DATA ITEM    *
*     .                    IS GIVEN BELOW INCLUDING SUGGESTED   *
*     .                    NAMES FOR THE PSEUDO MATRICES BEING  *
*     ...                  GENERATED.                           *
*                                                               *
*     -------------------------------------------------         *
*     |00000000011111111112222222222333333333344444444445       *
*     |12345678901234567890123456789012345678901234567890       *
*     -------------------------------------------------         *
*     |SA09 LABEL(9),STABCOND                                   *
*     -------------------------------------------------         *
*                                                               *
*     FORMAT = (5X, A4, 2X, I1, 2X, A8). NUMBER OF CARDS IS 1.  *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.           *
*                                                               *
*****************************************************************
*                                                               *
*     TYPICAL EXAMPLE OF A STABILITY TABLE IS ILLUSTRATED IN    *
*     FIGURES 8 AND 9.                                          *
*                                                               *
*     REPEAT THE FOLLOWING THREE ITEMS                          *
*     FOR EACH STABILITY CONDITION                              *
*     UNTIL A BLANK CARD IS ENCOUNTERED.                        *
*                                                               *
* 35. ... K                CONSTRUCTION CODE (SEE               *
*     .                    'CONSTRUCTION' VARIABLE IN ITEM      *
*     .                    28).                                 *
*     .                                                         *
*     .   L1N ≤ 9          NUMBER OF ABSCISSAS (FIRST           *
*     .                    INDEPENDENT VARIABLE).               *
*     .                                                         *
*     .   L2N ≤ 9          NUMBER OF CURVES (NUMBER OF VALUES   *
*     .                    FOR SECOND INDEPENDENT VARIABLE).    *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*       ... ISEQ = 0         SEQUENCE NUMBER.                                *
*                                                                            *
*       FORMAT = (8X,I4,2I2,54X,I2). NUMBER OF CARDS IS 1, FOR              *
*       EACH TABLE OF STABILITY DERIVATIVES BEING ENTERED.                   *
*                                                                            *
*       DATA ARE ENTERED BY SUBROUTINE NUREAD.                               *
*                                                                            *
******************************************************************************
*                                                                            *
*                                                                            *
*       ENTER (TEN VALUES OR LESS PER CARD)                                  *
*       FOR THE FOLLOWING ITEM FOR K= 1,....,L1N.                            *
*                                                                            *
* 36.   ... FIRST(K)         K'TH VALUE OF ABSCISSA. (FIRST                  *
*       .                    INDEPENDENT VARIABLE).                          *
*       .                                                                    *
*       ... ISEQ = 1         SEQUENCE NUMBER.                                *
*                                                                            *
*       FORMAT = (7X,9F7.0,I2). NUMBER OF CARDS IS 1, FOR EACH               *
*       TABLE OF STABILITY DERIVATIVES BEING ENTERED.                        *
*                                                                            *
*       DATA ARE ENTERED BY SUBROUTINE NUREAD.                               *
*                                                                            *
******************************************************************************
*                                                                            *
*                                                                            *
*       REPEAT THE FOLLOWING ITEM FOR L = 1,....,L2N.                        *
*                                                                            *
*       ENTER (TEN VALUES OR LESS PER CARD)                                  *
*       FOR THE FOLLOWING ITEM FOR K= 1,....,L1N.                            *
*                                                                            *
* 37.   ... QVALUE           SHEAR FLOW, LB/IN                               *
*       .                                                                    *
*       .   SECOND(K)        ALLOWABLE STRESS (PSI) FOR THE L'TH             *
*       .                    CURVE AND K'TH VALUE OF THE                     *
*       .                    ABSCISSA.                                       *
*       .                                                                    *
*       ... ISEQ = 2,10      SEQUENCE NUMBER.                                *
*                                                                            *
*       FORMAT = (10F7.0,I2). NUMBER OF CARDS IS L2N, FOR EACH               *
*       TABLE OF STABILITY DERIVATIVES BEING ENTERED.                        *
*                                                                            *
*       DATA ARE ENTERED BY SUBROUTINE NUREAD.                               *
*                                                                            *
******************************************************************************
*                                                                            *
*       REPEAT FOR EACH STABILITY CONDITION UNTIL A BLANK CARD               *
*       IS ENCOUNTERED.                                                      *
*                                                                            *
******************************************************************************
```

```
ITEM     DATA              DESCRIPTION
----     ----              -----------

*      H.  END OF RUN IN ASAM/ASOM                                        *
*      --------------------------                                         *
*                                                                         *
* 38. ... LABEL CARD       SPECIFIC FORMAT FOR THE END OF ALL             *
*      .                   INPUT (IDENTIFIED BY LABELS) INTO              *
*      ...                 ASAM/ASOM IS GIVEN BELOW.                      *
*                                                                         *
*     |--------------------------------------------------|                *
*     |00000000011111111112222222222333333333344444444445|                *
*     |12345678901234567890123456789012345678901234567890|                *
*     |--------------------------------------------------|                *
*     |     LABEL(0),ENDSARUN                            |                *
*     |--------------------------------------------------|                *
*                                                                         *
*      FORMAT = (5X, A4, 2X, I1, 2X, A8) NUMBER OF CARDS IS 1.            *
*                                                                         *
*      DATA ARE ENTERED BY SUBROUTINES LDB AND CARDIN.                    *
*                                                                         *
***************************************************************************
*                                                                         *
* 39. ... LOGIC ITEM           *** NO DATA ***                            *
*                                                                         *
*      IF A FREE-FREE WING IS BEING ANALYZED (KLUE(26) = 26)              *
*      ENTER DATA FOR THE FOLLOWING ITEM. OTHERWISE (KLUE(26) =           *
*      0) OMIT THIS ITEM.                                                 *
*                                                                         *
***************************************************************************
*                                                                         *
* 40. ... GEOPL(1)         X COORDINATE OF PLUG REFERENCE                 *
*      .                   POINT WITH RESPECT TO THE ORIGIN OF            *
*      .                   THE DYNAMICS COORDINATE AXES,                  *
*      .                   POSITIVE AFT.                                  *
*      .                                                                  *
*      .  GEOPL(2)         Y COORDINATE OF PLUG REFERENCE                 *
*      .                   POINT WITH RESPECT TO THE ORIGIN OF            *
*      .                   THE DYNAMICS COORDINATE AXES.                  *
*      .                   POSITIVE TO THE LEFT.                          *
*      .                                                                  *
*      .  GEOPL(3)         Z COORDINATE OF PLUG REFERENCE                 *
*      .                   POINT WITH RESPECT TO THE ORIGIN OF            *
*      .                   THE DYNAMICS COORDINATE AXES.                  *
*      ...                 POSITIVE UP.                                   *
*                                                                         *
*      FORMAT = (3E12.4).  NUMBER OF CARDS IS 1.                          *
*                                                                         *
*      DATA ARE ENTERED BY SUBROUTINE LAMBDA.                             *
*                                                                         *
***************************************************************************
```

ATAM - AUTOMATED TRANSFORMATION ANALYSIS MODULE

I. PREPARATION OF CARD DATA

CARD INPUT DATA MUST ALWAYS BE ENTERED FOR THE MAIN PROGRAM. REMAINING DATA WILL DEPEND UPON THE OPTIONS THE USER IS EXERCISING.

THE TRANSFORMATION ANALYSIS IS CAPABLE OF PERFORMING THE FOLLOWING TRANSFORMATIONS.

1. TRANSFORMATIONS BETWEEN THE AERODYNAMICS AND STRUCTURES GRIDS.
2. TRANSFORMATIONS BETWEEN THE WEIGHTS AND STRUCTURES GRIDS.
3. TRANSFORMATIONS BETWEEN THE DYNAMICS AND STRUCTURES GRIDS.

```
1. ... TA00            IDENTIFIES THE BEGINNING OF THE
   .                   CARD INPUT DATA TO THE AUTOMATED
   .                   TRANSFORMATION ANALYSIS MODULE
   ...                 (ATAM). MUST BE ENTERED AS SHOWN.
```

USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE AND REFERENCE PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT THE END OF EACH EXECUTION. REMAINING COLUMNS (FIVE TO SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION THE USER WISHES TO INCLUDE.

```
 ----------
|0000000001|
|1234567890|
|----------|
|TA00|     |
 ----------
```

FORMAT = (1A4). NUMBER OF CARDS IS 1.

DATA ARE ENTERED BY SUBROUTINE ATAM AND SUBROUTINE LDB WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE PROPER HEADING FOR THE TABLE OF CONTENTS.

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     ENTER (SIXTEEN WORDS PER CARD)                                   *
*     FOR THE FOLLOWING ITEM FOR L=1,....,16.                          *
*                                                                      *
*  2. ... TSHT(L)          SUBTITLE CONSISTING OF ONE CARD.            *
*                                                                      *
*     WILL BE LISTED AFTER THE MAIN TITLE AT THE TOP OF EACH           *
*     PAGE OF THE LISTED RESULTS AND WILL BE USED TO DEFINE            *
*     THE TYPE OF TRANSFORMATION ANALYSIS BEING PERFORMED.             *
*      THE SUBTITLE IS INCREASED TO EIGHTEEN WORDS WITHIN THE          *
*     PROGRAMS WHERE THE LAST TWO WORDS ARE USED TO IDENTIFY           *
*     THE PROGRAM FROM WHICH RESULTS ARE LISTED.                       *
*                                                                      *
*     FORMAT = (16A4).  NUMBER OF CARDS IS 1.                          *
*                                                                      *
*     DATA ARE ENTERED BY THE SUBROUTINE ATAM.                         *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*        ALL CLUE VALUES INCLUDING ZEROS MAY BE ENTERED IF THE         *
*     USER SO DESIRES.  IF THE USER WISHES TO MINIMIZE THE             *
*     AMOUNT OF DATA, HE MAY ENTER ONLY NON-ZERO CLUE VALUES           *
*     ACCORDING TO THE PROCEDURE DISCUSSED IN 'CONTROL WORD            *
*     OPTION' SECTION. REGARDLESS OF WHICH APPROACH IS TAKEN           *
*     THE LAST NON-ZERO VALUE ON THE LAST CARD MUST BE                 *
*     PRECEDED BY A NEGATIVE SIGN.                                     *
*                                                                      *
*  3. ... KLUET( 1) =  0 DO NOT CALCULATE THE AERODYNAMICS             *
*     .                  TO STRUCTURES GRID TRANSFORMATION             *
*     .                  MATRICES.                                     *
*     .             =  1 CALCULATE THE AERODYNAMICS TO                 *
*     .                  STRUCTURES GRID TRANSFORMATION                *
*     .                  MATRICES.                                     *
*     .                                                                *
*     .   KLUET( 2) =  0 DO NOT CALCULATE THE WEIGHTS TO               *
*     .                  STRUCTURES GRID TRANSFORMATION                *
*     .                  MATRICES.                                     *
*     .             =  2 CALCULATE THE WEIGHTS TO STRUCTURES           *
*     .                  GRID TRANSFORMATION MATRICES.                 *
*     .                                                                *
*     .   KLUET( 3) =  0 DO NOT LIST INTERMEDIATE OUTPUT IN            *
*     .                  THE TRANSFORMATION CALCULATIONS.              *
*     .             =  3 LIST INTERMEDIATE OUTPUT IN THE               *
*     .                  TRANSFORMATION CALCULATIONS.                  *
*     .                                                                *
*     .   KLUET( 4) =  0 DO NOT CALCULATE THE DYNAMICS TO              *
*     .                  STRUCTURES GRID TRANSFORMATION                *
*     .                  MATRIX.                                       *
*     .             =  4 CALCULATE THE DYNAMICS TO                     *
*     .                  STRUCTURES GRID TRANSFORMATION                *
*     .                  MATRIX.  KLUET(4) = 4 IF KLUES(8) =           *
*     .                  8.                                            *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*      .    KLUET( 5) = 0   USE AERODYNAMICS GRID GEOMETRY          *
*      .                    GENERATED IN SUBSONIC FLOW.             *
*      .                                                            *
*      .              = 5   USE AERODYNAMICS GRID GEOMETRY          *
*      ...                  GENERATED IN SUPERSONIC FLOW.           *
*                                                                   *
*      NOTE THAT IF BOTH SUBSONIC AND SUPERSONIC LOADS ARE          *
*      BEING COMPUTED IN THIS RUN, THEN THE USER MUST USE           *
*      IDENTICAL GRID GEOMETRY FOR BOTH CASES. (SEE ALAM) AND       *
*      SET KLUET(5) = 0.                                            *
*                                                                   *
*      FORMAT = (10I4).  NUMBER OF CARDS IS 1.                      *
*                                                                   *
*      DATA ARE ENTERED BY THE SUBROUTINE ATAM THROUGH THE          *
*      SUBROUTINE CLUES.                                            *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
*                                                                   *
*      A.  STRUCTURES GEOMETRY GRID                                 *
*      ----------------------------                                 *
*                                                                   *
*                                                                   *
*      THE FOLLOWING THREE ITEMS PROVIDE THE GEOMETRY OF THE        *
*      STRUCTURES GRID AND MUST ALWAYS BE ENTERED AS DATA IF        *
*      ONE OR ANY COMBINATION OF THE THREE, AERODYNAMICS,           *
*      WEIGHTS, AND DYNAMICS GRIDS TRANSFORMATIONS, ARE BEING       *
*      EXECUTED.                                                    *
*                                                                   *
*  4.  ... TA01             IDENTIFIES THE BEGINNING OF THE         *
*      .                    CARD INPUT DATA TO THE STRUCTURES       *
*      .                    GRID GEOMETRY SUBMODULE, IN THE         *
*      .                    AUTOMATED TRANSFORMATION ANALYSIS       *
*      .                    MODULE (ATAM). MUST BE ENTERED AS       *
*      ...                  SHOWN.                                  *
*                                                                   *
*      USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE      *
*      AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT        *
*      THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO       *
*      SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION     *
*      THE USER WISHES TO INCLUDE.                                  *
*                                                                   *
*      ------------                                                 *
*      |0000000001|                                                 *
*      |1234567890|                                                 *
*      |----------|                                                 *
*      |TA01|     |                                                 *
*      ------------                                                 *
*                                                                   *
*      FORMAT = (1A4).  NUMBER OF CARDS IS 1.                       *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     DATA ARE ENTEFED BY SUBROUTINE S2 AND SUBROUTINE LDB          *
*     WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE       *
*     PROPER HEADING FOR THE TABLE OF CONTENTS.                     *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
*  5. ... NSGEO≤1000     NUMBER OF STRUCTURES GEOMETRY GRID         *
*     ...                POINTS.                                    *
*                                                                   *
*     FORMAT = (1I4,4X).  NUMBER OF CARDS IS 1.                     *
*                                                                   *
*     DATA ARE ENTERED BY SUBFOUTINE S2.                            *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
*     REPEAT THE FOLLCWING ITEM FOR M = 1,...,NSGEO.                *
*                                                                   *
*  6. ... ISGEC(M)       THE NUMBER CF THE STRUCTURES GRID          *
*     .                  POINT.                                     *
*     .                                                             *
*     .   XSGEO(M)       X CCCRDINATE, RELATIVE TO THE              *
*     .                  STRUCTURES COORDINATE SYSTEM               *
*     .                  ORIGIN, OF THE M'TH STRUCTURES             *
*     .                  GEOMETRY GRID POINT, POSITIVE AFT,         *
*     .                  IN.                                        *
*     .                                                             *
*     .   YSGEO(M)       Y COORDINATE, RELATIVE TO THE              *
*     .                  STRUCTURES COORDINATE SYSTEM               *
*     .                  ORIGIN, OF THE M'TH STRUCTURES             *
*     .                  GECMETRY GRID POINT, POSITIVE TO           *
*     .                  THE LEFT, IN.                              *
*     .                                                             *
*     .   ZSGEO(M)       Z COORDINATE, RELATIVE TO THE              *
*     .                  STRUCTURES COORDINATE SYSTEM               *
*     .                  ORIGIN, OF THE M'TH STRUCTURES             *
*     .                  GECMETRY GRID POINT, POSITIVE UP,          *
*     ...                IN.                                        *
*                                                                   *
*     FORMAT = (I4, 3E13.6).  NUMBER OF CARDS IS NSGEO.             *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE S2.                            *
*                                                                   *
*********************************************************************
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*                                                                  *
*                                                                  *
********************************************************************
*     B.  TRANSFORMATIONS BETWEEN AERODYNAMICS AND                 *
*     ----------------------------------------------               *
*         STRUCTURES GRIDS                                         *
*         ----------------                                         *
*                                                                  *
********************************************************************
*                                                                  *
*  7. ... LOGIC ITEM          *** NO DATA ***                      *
*                                                                  *
*     IF TRANSFORMATION ANALYSIS FOR THE AERODYNAMICS GRID IS      *
*     TO BE PERFORMED (KLUET(1) = 1) ENTER THE FOLLOWING SIX       *
*     ITEMS. OTHERWISE (KLUET(1) = 0) OMIT THESE ITEMS.            *
*                                                                  *
********************************************************************
*                                                                  *
*     1.  CORRESPONDENCE TABLE                                     *
*     ------------------------                                     *
*                                                                  *
********************************************************************
*                                                                  *
*  8. ... TAC1              IDENTIFIES THE BEGINNING OF THE        *
*     .                     CARD INPUT DATA TO THE                 *
*     .                     TRANSFORMATIONS BETWEEN                *
*     .                     AERODYNAMICS AND STRUCTURES GRID       *
*     .                     SUBMODULE, IN THE AUTOMATED            *
*     .                     TRANSFORMATION ANALYSIS MODULE         *
*     ...                   (ATAM). MUST BE ENTERED AS SHOWN.      *
*                                                                  *
*     USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE      *
*     AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT        *
*     THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO       *
*     SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION     *
*     THE USER WISHES TO INCLUDE.                                  *
*                                                                  *
*     |----------|                                                 *
*     |0000000001|                                                 *
*     |1234567890|                                                 *
*     |----------|                                                 *
*     |TAC1|     |                                                 *
*     |----------|                                                 *
*                                                                  *
*     FORMAT = (1A4).  NUMBER OF CARDS IS 1.                       *
*                                                                  *
*     DATA ARE ENTERED BY SUBROUTINE S2 AND SUBROUTINE LDB         *
*     WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE      *
*     PROPER HEADING FOR THE TABLE OF CONTENTS.                    *
*                                                                  *
********************************************************************
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*     SINCE THE SIGN CONVENTION FOR THE AERODYNAMIC LOADS AND    *
*     THE STRUCTURES MODEL LOADS IS THE SAME, THE UNIT FORCES    *
*     IN THE AERODYNAMICS GRID ARE USED AS GIVEN.                 *
*                                                                 *
*                                                                 *
*  9. ... NIGEOC             NUMBER OF AERODYNAMICS GRID POINTS   *
*     .                      IN THE CORRESPONDENCE TABLE BETWEEN  *
*     .                      THE AERODYNAMICS AND STRUCTURES      *
*     .                      GRIDS. NOTE THAT FOR SUBSONIC FLOW   *
*     .                      NIGEOC IS EQUAL TO OR LESS THAN ONE  *
*     .                      HUNDRED AND FIFTY WHEREAS FOR        *
*     .                      SUPERSONIC FLOW NIGEOC IS EQUAL TO   *
*     .                      OR LESS THAN ONE HUNDRED.            *
*     .                                                           *
*     .   NDOF (=NIGEOC)     NUMBER OF AERODYNAMICS GRID UNIT     *
*     .                      FORCES.  FOR EACH AERODYNAMICS GRID  *
*     .                      POINT ONLY THE Z FORCE COMPONENT IS  *
*     .                      REQUIRED.                            *
*     .                                                           *
*     .   NSGEOU = 0         DUMMY VARIABLE.                      *
*     .                                                           *
*     .   NIGEOL≤NIGEOC      LOWER VALUE OF AERODYNAMICS GRID     *
*     .                      POINT FOR WHICH INTERMEDIATE OUTPUT  *
*     .                      IN THE TRANSFORMATION ANALYSIS IS    *
*     .                      DESIRED.  IF KLUET(3) = 0, LET       *
*     .                      NIGEOL = 0.                          *
*     .                                                           *
*     .   NIGEOU≤NIGEOC      UPPER VALUE OF AERODYNAMICS GRID     *
*     .                      POINT FOR WHICH INTERMEDIATE OUTPUT  *
*     .                      IN THE TRANSFORMATION ANALYSIS IS    *
*     .                      DESIRED.  IF KLUET(3) = 0, LET       *
*     ...                    NIGEOU = 0.                          *
*                                                                 *
*     FORMAT (5I4).  NUMBER OF CARDS IS 1.                        *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE S2.                          *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
* 10. ... XREFT              X DISTANCE BETWEEN STRUCTURES AND    *
*     .                      AERODYNAMIC SURFACE COORDINATE       *
*     .                      SYSTEM ORIGINS, POSITIVE FOR         *
*     .                      AERODYNAMIC SURFACE AFT OF           *
*     .                      STRUCTURES COORDINATE SYSTEM, IN.    *
*     .                                                           *
*     .   YREFT              Y DISTANCE BETWEEN STRUCTURES AND    *
*     .                      AERODYNAMIC SURFACE COORDINATE       *
*     .                      SYSTEM ORIGINS, POSITIVE FOR         *
*     .                      AERODYNAMIC SURFACE TO THE LEFT OF   *
*     .                      STRUCTURES COORDINATE SYSTEM, IN.    *
```

```
 ITEM       DATA               DESCRIPTION
 ----       ----               -----------

*     .   ZREFT              Z DISTANCE BETWEEN STRUCTURES AND       *
*     .                      AERODYNAMIC SURFACE COORDINATE          *
*     .                      SYSTEM ORIGINS. POSITIVE FOR            *
*     .                      AERODYNAMIC SURFACE ABOVE               *
*     ...                    STRUCTURES COORDINATE SYSTEM, IN.       *
*                                                                    *
*     FORMAT = (4X, 3E13.6) NUMBER OF CARDS IS 1.                    *
*                                                                    *
*     DATA ARE ENTERED BY SUBROUTINE S2.                             *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*     REPEAT THE FOLLOWING THREE ITEMS FOR I = 1,....,NIGEOC         *
*                                                                    *
*                                                                    *
* 11. ... NCORR( 1)          THE NUMBER OF THE AERODYNAMIC NODE      *
*     .                      TO BE BEAMED TO THE STRUCTURAL          *
*     .                      NODES. (IDENTICAL TO AERODYNAMIC        *
*     .                      PANEL NUMBERING SYSTEM).                *
*     .                                                              *
*     .   NCORR( 2)          FIELD FOR STRUCTURES NODE I TO          *
*     .                      WHICH THE AERODYNAMIC NODE WILL BE      *
*     .                      BEAMED IN ACCORDANCE WITH THE           *
*     .                      BEAMING TYPE CLUE DESCRIBED BELOW       *
*     .                      (NCORR(6)).                             *
*     .                                                              *
*     .   NCORR( 3)          FIELD FOR STRUCTURES NODE J TO          *
*     .                      WHICH THE AERODYNAMIC NODE WILL BE      *
*     .                      BEAMED IN ACCORDANCE WITH THE           *
*     .                      BEAMING TYPE CLUE DESCRIBED BELOW       *
*     .                      (NCORR(6)).                             *
*     .                                                              *
*     .   NCORR( 4)          FIELD FOR STRUCTURES NODE K TO          *
*     .                      WHICH THE AERODYNAMIC NODE WILL BE      *
*     .                      BEAMED IN ACCORDANCE WITH THE           *
*     .                      BEAMING TYPE CLUE DESCRIBED BELOW       *
*     .                      (NCORR(6)).                             *
*     .                                                              *
*     .   NCORR( 5)          FIELD FOR STRUCTURES NODE L TO          *
*     .                      WHICH THE AERODYNAMIC NODE WILL BE      *
*     .                      BEAMED IN ACCORDANCE WITH THE           *
*     .                      BEAMING TYPE CLUE DESCRIBED BELOW       *
*     .                      (NCORR(6)).                             *
*     .                                                              *
*     .   NCORR( 6)          BEAMING TYPE CLUE.  THE THREE TYPES     *
*     .                      OF BEAMING CLUES ALLOWED ARE            *
*     .                      DISCUSSED BELOW.  NOTE THAT THE         *
*     .                      SEQUENCE OF CALLOUT USING THE           *
*     .                      NUMBERED NODES IS ALWAYS IN A 'Z'       *
*     .                      PATTERN.                                *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     .                      1.  ORDERED SIMPLE BEAMING TO EIGHT    *
*     .                      NODES.  THE CLUE 'B' IN EITHER         *
*     .                      COLUMN 21 OR 22 (NOT IN BOTH)          *
*     .                      INDICATES ORDERED SIMPLE BEAMING TO    *
*     .                      EIGHT NODES.  THE FIRST BEAMING        *
*     .                      PLANE (TOP SURFACE) USES ODD           *
*     .                      NUMBERED NODES (I, J, K, AND L)        *
*     .                      PROVIDED BY THE USER.  THE SECOND      *
*     .                      BEAMING PLANE (BOTTOM SURFACE) USES    *
*     .                      EVEN NUMBERED NODES (N, O, P, AND      *
*     .                      Q) AUTOMATICALLY ASSIGNED BY THE       *
*     .                      PROGRAM.                               *
*     .                                                             *
*     .                      2.  CANTILEVERED BEAMING TO FOUR       *
*     .                      NODES.  THE CLUE 'C' IN COLUMN 21      *
*     .                      OR 22 (NOT IN BOTH) INDICATES          *
*     .                      CANTILEVERED BEAMING TO FOUR NODES     *
*     .                      (I, J, K, AND L) PROVIDED BY USER.     *
*     .                                                             *
*     .                      3.  NON-ORDERED SIMPLE BEAMING TO      *
*     .                      EIGHT NODES.  THE CLUE 'BB' IN         *
*     .                      COLUMNS 21 AND 22 INDICATES            *
*     .                      NON-ORDERED SIMPLE BEAMING TO EIGHT    *
*     .                      NODES (I, J, K, L, N, O, P, AND Q)     *
*     .                      PROVIDED BY THE USER.  NODES I, J,     *
*     .                      K, AND L SHOULD BE PUNCHED ON THIS     *
*     .                      CARD.  NODES N, O, P, AND Q SHOULD     *
*     .                      BE PUNCHED ON THE NEXT CARD AS         *
*     .                      SHOWN IN THE FOLLOWING ITEM.           *
*     .                      WHEN USING 'BB' THERE IS NO            *
*     .                      RESTRICTION AS TO WHICH NODES ARE      *
*     .                      ODD NUMBERED AND WHICH ARE EVEN        *
*     .                      NUMBERED.                              *
*     .                                                             *
*     .    NCORR( 7) = 0     FIXED VARIABLE, EQUAL TO ZERO.         *
*     .                                                             *
*     .    NCORR( 8) = 0     FIXED VARIABLE, EQUAL TO ZERO.         *
*     .                                                             *
*     .    NCORR( 9) = 1     FIXED VARIABLE.                        *
*     .                                                             *
*     .    NCORR(10) = 0     FIXED VARIABLE, EQUAL TO ZERO.         *
*     .                                                             *
*     .    NCORR(11) = 0     FIXED VARIABLE, EQUAL TO ZERO.         *
*     .                                                             *
*     .    NCORR(12) = 0     FIXED VARIABLE, EQUAL TO ZERO.         *
*     .                                                             *
*     ... THETAZ             DUMMY VARIABLE.  EQUAL TO ZERO.        *
*                                                                   *
*     NOTE THAT THE SUM OF ONES (NCORR(K), K = 7,....,12,  I =      *
*     1,....,NIGEOC) MUST BE EQUAL TO THE VALUE OF THE VARIABLE     *
*     NDOF ENTERED AS DATA IN ITEM 9.                               *
```

```
 ITEM       DATA              DESCRIPTION
 ----       ----              -----------

*      FORMAT = (5I4,A2,6I2,F6.2). NUMBER OF CARDS IS ONE FOR     *
*      EACH AERODYNAMICS GRID POINT.                              *
*                                                                 *
*      DATA ARE ENTERED BY SUBROUTINE S2.                         *
*                                                                 *
*******************************************************************
*                                                                 *
* 12. ... LOGIC ITEM          *** NO DATA ***                     *
*                                                                 *
*                                                                 *
*      IF BEAMING TYPE CLUE (NCORR(6)) IS '8B' ENTER THE          *
*      FOLLOWING ITEM, OTHERWISE IF BEAMING TYPE CLUE IS '8' OR   *
*      'C' OMIT THIS ITEM.                                        *
*                                                                 *
*******************************************************************
*                                                                 *
* 13. ... NCORR(13)        FIELD FOR STRUCTURES NODE N TO         *
*      .                   WHICH THE AERODYNAMIC NODE WILL BE     *
*      .                   BEAMED IN ACCORDANCE WITH THE          *
*      .                   BEAMING TYPE CLUE DESCRIBED IN ITEM    *
*      .                   ABOVE (NCORR(6)).                      *
*      .                                                          *
*      .  NCORR(14)        FIELD FOR STRUCTURES NODE O TO         *
*      .                   WHICH THE AERODYNAMIC NODE WILL BE     *
*      .                   BEAMED IN ACCORDANCE WITH THE          *
*      .                   BEAMING TYPE CLUE DESCRIBED IN ITEM    *
*      .                   ABOVE (NCORR(6)).                      *
*      .                                                          *
*      .  NCORR(15)        FIELD FOR STRUCTURES NODE P TO         *
*      .                   WHICH THE AERODYNAMIC NODE WILL BE     *
*      .                   BEAMED IN ACCORDANCE WITH THE          *
*      .                   BEAMING TYPE CLUE DESCRIBED IN ITEM    *
*      .                   ABOVE (NCORR(6)).                      *
*      .                                                          *
*      .  NCORR(16)        FIELD FOR STRUCTURES NODE Q TO         *
*      .                   WHICH THE AERODYNAMIC NODE WILL BE     *
*      .                   BEAMED IN ACCORDANCE WITH THE          *
*      .                   BEAMING TYPE CLUE DESCRIBED IN ITEM    *
*      ...                 ABOVE (NCORR(6)).                      *
*                                                                 *
*      FORMAT = (4X,4I4). NUMBER OF CARDS IS ONE FOR EACH         *
*      AERODYNAMICS GRID POINT.                                   *
*                                                                 *
*      DATA ARE ENTERED BY SUBROUTINE S2.                         *
*                                                                 *
*******************************************************************
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*                                                                       *
*                                                                       *
*************************************************************************
*     C.  TRANSFORMATIONS BETWEEN WEIGHTS AND STRUCTURES GRIDS          *
*         -------------------------------------------------------       *
*                                                                       *
*************************************************************************
*                                                                       *
* 14. ... LOGIC ITEM          *** NO DATA ***                           *
*                                                                       *
*     IF TRANSFORMATION ANALYSIS FOR THE WEIGHTS GRID IS TO BE          *
*     PERFORMED (KLUET(2) = 2) ENTER THE FOLLOWING SIX ITEMS,           *
*     OTHERWISE (KLUET(2) = 0) OMIT THESE ITEMS.                        *
*                                                                       *
*************************************************************************
*                                                                       *
*     1.  CORRESPONDENCE TABLE                                          *
*         --------------------                                          *
*                                                                       *
*************************************************************************
*                                                                       *
* 15. ... TAC2              IDENTIFIES THE BEGINNING OF THE             *
*     .                     CARD INPUT DATA TO THE                      *
*     .                     TRANSFORMATIONS BETWEEN WEIGHTS AND         *
*     .                     STRUCTURES GRIDS SUBMODULE, IN THE          *
*     .                     AUTOMATED TRANSFORMATION ANALYSIS           *
*     .                     MODULE (ATAM). MUST BE ENTERED AS           *
*     ...                   SHOWN.                                      *
*                                                                       *
*     USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE           *
*     AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT             *
*     THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO            *
*     SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION          *
*     THE USER WISHES TO INCLUDE.                                       *
*                                                                       *
*     ------------                                                      *
*     |0000000001|                                                      *
*     |1234567890|                                                      *
*     ------------                                                      *
*     |TAC2|     |                                                      *
*     ------------                                                      *
*                                                                       *
*     FORMAT = (1A4).  NUMBER OF CARDS IS 1.                            *
*                                                                       *
*     DATA ARE ENTERED BY SUBROUTINE S2 AND SUBROUTINE LDB              *
*     WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE           *
*     PROPER HEADING FOR THE TABLE OF CONTENTS.                         *
*                                                                       *
*************************************************************************
*                                                                       *
*     SINCE THE SIGN CONVENTION FOR THE INERTIAL LOADS AND THE          *
*     STRUCTURES MODEL LOADS IS THE SAME, THE UNIT FORCES AND           *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*     MOMENTS IN THE WEIGHTS GRID ARE USED AS GIVEN.                  *
*                                                                     *
*                                                                     *
* 16. ... NIGEOC ≤ 1100   NUMBER OF DISTRIBUTED AND                   *
*     .                   CONCENTRATED WEIGHTS GRID POINTS IN         *
*     .                   THE CORRESPONDENCE TABLE BETWEEN            *
*     .                   THE WEIGHTS AND STRUCTURES GRIDS.           *
*     .                                                               *
*     .   NDOF≤6*NIGEOC   NUMBER OF WEIGHTS GRID DEGREES OF           *
*     .                   FREEDOM (UNIT FORCE AND MOMENT              *
*     .                   INPUTS).  FOR EACH WEIGHTS GRID             *
*     .                   POINT A MAXIMUM OF SIX DEGREES OF           *
*     .                   FREEDOM MAY BE COUNTED - THREE FOR          *
*     .                   THE X, Y, Z FORCE COMPONENTS AND            *
*     .                   THREE FOR THE X, Y, Z MOMENT                *
*     .                   COMPONENTS.  THIS NUMBER WILL               *
*     .                   DEPEND ON THE VALUES OF NCORR(K). K         *
*     .                   = 7,....,12, I = 1,...,NIGEOC,              *
*     .                   ENTERED AS DATA IN THE ITEM BELOW.          *
*     .                                                               *
*     .   NSGEOU = 0      DUMMY VARIABLE.                             *
*     .                                                               *
*     .   NIGEOL≤NIGEOU   LOWER VALUE OF WEIGHTS GRID POINT           *
*     .                   FOR WHICH INTERMEDIATE OUTPUT IN            *
*     .                   THE TRANSFORMATION ANALYSIS IS              *
*     .                   DESIRED.  IF KLUET(3) = 0, LET              *
*     .                   NIGEOL = 0.                                 *
*     .                                                               *
*     .   NIGEOU≤NIGECC   UPPER VALUE OF WEIGHTS GRID POINT           *
*     .                   FOR WHICH INTERMEDIATE OUTPUT IN            *
*     .                   THE TRANSFORMATION ANALYSIS IS              *
*     .                   DESIRED.  IF KLUET(3) = 0, LET              *
*     ...                 NIGEOU = 0.                                 *
*                                                                     *
*     FORMAT (5I4).  NUMBER OF CARDS IS 1.                            *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE S2.                              *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
* 17. ... XREFT           X DISTANCE BETWEEN STRUCTURES AND           *
*     .                   WEIGHT SURFACE COORDINATE SYSTEM            *
*     .                   ORIGINS, POSITIVE FOR WEIGHT                *
*     .                   SURFACE AFT OF STRUCTURES                   *
*     .                   COORDINATE SYSTEM, IN.                      *
*     .                                                               *
*     .   YREFT           Y DISTANCE BETWEEN STRUCTURES AND           *
*     .                   WEIGHT SURFACE COORDINATE SYSTEM            *
*     .                   ORIGINS, POSITIVE FOR WEIGHT                *
*     .                   SURFACE TO THE LEFT OF STRUCTURES           *
*     .                   COORDINATE SYSTEM, IN.                      *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*       .   ZREFT            Z DISTANCE BETWEEN STRUCTURES AND        *
*       .                    WEIGHT SURFACE COORDINATE SYSTEM         *
*       .                    ORIGINS. POSITIVE FOR WEIGHT             *
*       .                    SURFACE ABOVE STRUCTURES COORDINATE      *
*       ...                  SYSTEM, IN.                              *
*                                                                     *
*      FORMAT = (4X, 3E13.6). NUMBER OF CARDS IS 1.                   *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE S2.                             *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*      REPEAT THE FOLLOWING THREE ITEMS FOR I = 1,...,NIGEOC          *
*                                                                     *
*                                                                     *
* 18. ... NCORR( 1)          THE NUMBER OF THE WEIGHT NODE TO BE      *
*       .                    BEAMED TO THE STRUCTURAL NODES.          *
*       .                    (WEIGHT NODES ARE NUMBERED               *
*       .                    SEQUENTIALLY IN THE ORDER IN WHICH       *
*       .                    THEIR COORDINATES ARE ENTERED IN         *
*       .                    ITEMS 24, 26 OF ALAM)                    *
*       .                                                             *
*       .   NCORR( 2)        FIELD FOR STRUCTURES NODE I TO           *
*       .                    WHICH THE WEIGHT NODE WILL BE            *
*       .                    BEAMED IN ACCORDANCE WITH THE            *
*       .                    BEAMING TYPE CLUE DESCRIBED BELOW        *
*       .                    (NCORR(6)).                              *
*       .                                                             *
*       .   NCORR( 3)        FIELD FOR STRUCTURES NODE J TO           *
*       .                    WHICH THE WEIGHT NODE WILL BE            *
*       .                    BEAMED IN ACCORDANCE WITH THE            *
*       .                    BEAMING TYPE CLUE DESCRIBED BELOW        *
*       .                    (NCORR(6)).                              *
*       .                                                             *
*       .   NCORR( 4)        FIELD FOR STRUCTURES NODE K TO           *
*       .                    WHICH THE WEIGHT NODE WILL BE            *
*       .                    BEAMED IN ACCORDANCE WITH THE            *
*       .                    BEAMING TYPE CLUE DESCRIBED BELOW        *
*       .                    (NCORR(6)).                              *
*       .                                                             *
*       .   NCORR( 5)        FIELD FOR STRUCTURES NODE L TO           *
*       .                    WHICH THE WEIGHT NODE WILL BE            *
*       .                    BEAMED IN ACCORDANCE WITH THE            *
*       .                    BEAMING TYPE CLUE DESCRIBED BELOW        *
*       .                    (NCORR(6)).                              *
*       .                                                             *
*       .   NCORR( 6)        BEAMING TYPE CLUE.  THE THREE TYPES      *
*       .                    OF BEAMING CLUES ALLOWED ARE             *
*       .                    DISCUSSED BELOW.  NOTE THAT THE          *
*       .                    SEQUENCE OF CALLOUT USING THE            *
*       .                    NUMBERED NODES IS ALWAYS IN A 'Z'        *
```

```
 ITEM      DATA                DESCRIPTION
 ----      ----                -----------

*      .                       PATTERN.                                     *
*      .                                                                    *
*      .                       1.  ORDERED SIMPLE BEAMING TO EIGHT          *
*      .                       NODES.  THE CLUE 'B' IN EITHER               *
*      .                       COLUMN 21 OR 22 (NOT IN BOTH)                *
*      .                       INDICATES ORDERED SIMPLE BEAMING TO          *
*      .                       EIGHT NODES.  THE FIRST BEAMING              *
*      .                       PLANE (TOP SURFACE) USES ODD                 *
*      .                       NUMBERED NODES (I, J, K, AND L)              *
*      .                       PROVIDED BY THE USER.  THE SECOND            *
*      .                       BEAMING PLANE (BOTTOM SURFACE) USES          *
*      .                       EVEN NUMBERED NODES (N, O, P, AND            *
*      .                       Q) AUTOMATICALLY ASSIGNED BY THE             *
*      .                       PROGRAM.                                     *
*      .                                                                    *
*      .                       2.  CANTILEVERED BEAMING TO FOUR             *
*      .                       NODES.  THE CLUE 'C' IN COLUMN 21            *
*      .                       OR 22 (NOT IN BOTH) INDICATES                *
*      .                       CANTILEVERED BEAMING TO FOUR NODES           *
*      .                       (I, J, K, AND L) PROVIDED BY USER.           *
*      .                                                                    *
*      .                       3.  NON-ORDERED SIMPLE BEAMING TO            *
*      .                       EIGHT NODES.  THE CLUE '8B' IN               *
*      .                       COLUMNS 21 AND 22 INDICATES                  *
*      .                       NON-ORDERED SIMPLE BEAMING TO EIGHT          *
*      .                       NODES (I, J, K, L, N, O, P, AND Q)           *
*      .                       PROVIDED BY THE USER.  NODES I, J,           *
*      .                       K, AND L SHOULD BE PUNCHED ON THIS           *
*      .                       CARD.  NODES N, O, P, AND Q SHOULD           *
*      .                       BE PUNCHED ON THE NEXT CARD AS               *
*      .                       SHOWN IN THE FOLLOWING ITEM.                 *
*      .                       WHEN USING '8B' THERE IS NO                  *
*      .                       RESTRICTION AS TO WHICH NODES ARE            *
*      .                       ODD NUMBERED AND WHICH ARE EVEN              *
*      .                       NUMBERED.                                    *
*      .                                                                    *
*      .   NCORR( 7) = 0       DO NOT INCLUDE EFFECT OF X                   *
*      .                       COMPONENT OF INERTIAL FORCE IN THE           *
*      .                       WEIGHTS TO STRUCTURES GRID                   *
*      .                       TRANSFORMATION MATRIX.                       *
*      .             = 1       INCLUDE EFFECT OF X COMPONENT OF             *
*      .                       INERTIAL FORCE IN THE WEIGHTS TO             *
*      .                       STRUCTURES GRID TRANSFORMATION               *
*      .                       MATRIX.                                      *
*      .                                                                    *
*      .   NCORR( 8) = 0       DO NOT INCLUDE EFFECT OF Y                   *
*      .                       COMPONENT OF INERTIAL FORCE IN THE           *
*      .                       WEIGHTS TO STRUCTURES GRID                   *
*      .                       TRANSFORMATION MATRIX.                       *
*      .             = 1       INCLUDE EFFECT OF Y COMPONENT OF             *
*      .                       INERTIAL FORCE IN THE WEIGHTS TO             *
*      .                       STRUCTURES GRID TRANSFORMATION               *
```

```
ITEM      DATA               DESCRIPTION
----      ----               -----------

*     .                      MATRIX.                                   *
*     .                                                                *
*     .   NCCRR( 9) = 0      DO NOT INCLUDE EFFECT OF Z                *
*     .                      COMPONENT OF INERTIAL FORCE IN THE        *
*     .                      WEIGHTS TO STRUCTURES GRID                *
*     .                      TRANSFORMATION MATRIX.                    *
*     .             = 1      INCLUDE EFFECT OF Z COMPONENT OF          *
*     .                      INERTIAL FORCE IN THE WEIGHTS TO          *
*     .                      STRUCTURES GRID TRANSFORMATION            *
*     .                      MATRIX.                                   *
*     .                                                                *
*     .   NCORR(10) = 0      DO NOT INCLUDE EFFECT OF X                *
*     .                      COMPONENT OF INERTIAL MOMENT IN THE       *
*     .                      WEIGHTS TO STRUCTURES GRID                *
*     .                      TRANSFORMATION MATRIX.                    *
*     .             = 1      INCLUDE EFFECT OF X COMPONENT OF          *
*     .                      INERTIAL MOMENT IN THE WEIGHTS TO         *
*     .                      STRUCTURES GRID TRANSFORMATION            *
*     .                      MATRIX.                                   *
*     .                                                                *
*     .   NCORR(11) = 0      DO NOT INCLUDE EFFECT OF Y                *
*     .                      COMPONENT OF INERTIAL MOMENT IN THE       *
*     .                      WEIGHTS TO STRUCTURES GRID                *
*     .                      TRANSFORMATION MATRIX.                    *
*     .             = 1      INCLUDE EFFECT OF Y COMPONENT OF          *
*     .                      INERTIAL MOMENT IN THE WEIGHTS TO         *
*     .                      STRUCTURES GRID TRANSFORMATION            *
*     .                      MATRIX.                                   *
*     .                                                                *
*     .   NCORR(12) = 0      DO NOT INCLUDE EFFECT OF Z                *
*     .                      COMPONENT OF INERTIAL MOMENT IN THE       *
*     .                      WEIGHTS TO STRUCTURES GRID                *
*     .                      TRANSFORMATION MATRIX.                    *
*     .             = 1      INCLUDE EFFECT OF Z COMPONENT OF          *
*     .                      INERTIAL MOMENT IN THE WEIGHTS TO         *
*     .                      STRUCTURES GRID TRANSFORMATION            *
*     .                      MATRIX.                                   *
*     .                                                                *
*     ... THETAZ             DUMMY VARIABLE.  EQUAL TO ZERO.           *
*                                                                      *
*     NOTE THAT THE SUM OF ONES (NCCRR(K), K = 7,....,12.  I =         *
*     1,....,NIGEOC) MUST BE EQUAL TO THE VALUE OF THE VARIABLE        *
*     NDOF ENTERED AS DATA IN ITEM 16.                                 *
*                                                                      *
*     FORMAT = (5I4,A2,6I2,F6.2). NUMBER OF CARDS IS ONE FOR           *
*     EACH WEIGHTS GRID POINT.                                         *
*                                                                      *
*     DATA ARE ENTERED BY SUBROUTINE S2.                               *
*                                                                      *
************************************************************************
*                                                                      *
* 19. ... LOGIC ITEM            *** NO DATA ***                        *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*     IF BEAMING TYPE CLUE (NCORR(6)) IS 'BB' ENTER THE            *
*     FOLLOWING ITEM, OTHERWISE IF BEAMING TYPE CLUE IS 'B' OR     *
*     'C' OMIT THIS ITEM.                                          *
*                                                                  *
********************************************************************
*                                                                  *
* 20. ... NCORR(13)       FIELD FOR STRUCTURES NODE N TO           *
*     .                   WHICH THE WEIGHT NODE WILL BE            *
*     .                   BEAMED IN ACCORDANCE WITH THE            *
*     .                   BEAMING TYPE CLUE DESCRIBED IN ITEM      *
*     .                   ABOVE (NCORR(6)).                        *
*     .                                                            *
*     .   NCORR(14)       FIELD FOR STRUCTURES NODE O TO           *
*     .                   WHICH THE WEIGHT NODE WILL BE            *
*     .                   BEAMED IN ACCORDANCE WITH THE            *
*     .                   BEAMING TYPE CLUE DESCRIBED IN ITEM      *
*     .                   ABOVE (NCORR(6)).                        *
*     .                                                            *
*     .   NCORR(15)       FIELD FOR STRUCTURES NODE P TO           *
*     .                   WHICH THE WEIGHT NODE WILL BE            *
*     .                   BEAMED IN ACCORDANCE WITH THE            *
*     .                   BEAMING TYPE CLUE DESCRIBED IN ITEM      *
*     .                   ABOVE (NCORR(6)).                        *
*     .                                                            *
*     .   NCORR(16)       FIELD FOR STRUCTURES NODE Q TO           *
*     .                   WHICH THE WEIGHT NODE WILL BE            *
*     .                   BEAMED IN ACCORDANCE WITH THE            *
*     .                   BEAMING TYPE CLUE DESCRIBED IN ITEM      *
*     ...                 ABOVE (NCORR(6)).                        *
*                                                                  *
*     FORMAT = (4X,4I4). NUMBER OF CARDS IS ONE FOR EACH           *
*     WEIGHTS GRID POINT.                                          *
*                                                                  *
*     DATA ARE ENTERED BY SUBROUTINE S2.                           *
*                                                                  *
********************************************************************
```

```
*                                                                  *
*                                                                  *
********************************************************************
*     D.  TRANSFORMATIONS BETWEEN DYNAMICS AND STRUCTURES GRIDS    *
*         ---------------------------------------------------------*
*                                                                  *
********************************************************************
*                                                                  *
* 21. ... LOGIC ITEM          *** NO DATA ***                      *
*                                                                  *
*     IF TRANSFORMATION ANALYSIS FOR THE DYNAMICS GRID IS TO       *
*     BE PERFORMED (KLUET(4) = 4) ENTER THE FOLLOWING ELEVEN       *
*     ITEMS. OTHERWISE (KLUET(4) = 0) OMIT THESE ITEMS.            *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*     1.  DYNAMICS GRID GEOMETRY                                   *
*     --------------------------                                   *
*                                                                  *
********************************************************************
*                                                                  *
*     WHEN THE DEGREES OF FREEDOM OF THE DYNAMICS MODEL AND        *
*     STRUCTURAL MODEL ARE IDENTICAL, THEN THE STIFFNESS           *
*     MATRIX IS USED FOR VIBRATION ANALYSIS IN FOP. IF THE         *
*     DYNAMICS MODEL HAS A REDUCED NUMBER OF DEGREES OF            *
*     FREEDOM, THEN THE COORDINATES OF THE SELECTED DYNAMICS       *
*     POINTS MUST BE ENTERED AT THIS POINT.  THESE COORDINATES     *
*     ARE SUBSEQUENTLY USED IN GENERATING THE FORCE BEAMING        *
*     RELATIONSHIP FROM DYNAMIC NODES TO STRUCTURES NODES IN       *
*     ATAM AND THEN THE FLEXIBILITY MATRIX IN ASAM.  FINALLY,      *
*     THE FLEXIBILITY MATRIX, INSTEAD OF THE STIFFNESS MATRIX,     *
*     IS USED FOR VIBRATION ANALYSIS IN FOP. TO PERMIT MODAL       *
*     INTERPOLATION OPERATIONS IN AFAM, THE MAJORITY OF            *
*     DYNAMICS POINTS SHOULD BE CHOSEN SO AS TO LIE ALONG A        *
*     FEW (NOT NECESSARILY PARALLEL) STRAIGHT-LINE SEGMENTS        *
*     RUNNING FROM INBOARD TO OUTBOARD LOCATIONS ALONG THE         *
*     PRIMARY STRUCTURE OF THE SURFACE.                            *
*                                                                  *
********************************************************************
*                                                                  *
* 22. ... TADG                 IDENTIFIES THE BEGINNING OF THE     *
*     .                        CARD INPUT DATA TO THE DYNAMICS     *
*     ...                      GRID. MUST BE ENTERED AS SHOWN.     *
*                                                                  *
*     USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE      *
*     AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT        *
*     THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO       *
*     SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION     *
*     THE USER WISHES TO INCLUDE.                                  *
*                                                                  *
*     ----------                                                   *
```

ITEM DATA DESCRIPTION

```
*      |0000000001|                                                    *
*      |1234567890|                                                    *
*      |----------|                                                    *
*      |TADG|     |                                                    *
*      |----------|                                                    *
*                                                                      *
*      FORMAT = (1A4).  NUMBER OF CARDS IS 1.                          *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE DATADG AND SUBROUTINE LDB        *
*      WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE         *
*      PROPER HEADING FOR THE TABLE OF CONTENTS.                       *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*      THE FOLLOWING TWO ITEMS PROVIDE THE GEOMETRY OF THE             *
*      DYNAMICS GRID.                                                  *
*                                                                      *
*                                                                      *
* 23.  ... NDN ≤  200    NUMBER OF DYNAMICS GRID GEOMETRY              *
*      ...                POINTS.                                      *
*                                                                      *
*      FORMAT = (1I4).  NUMBER OF CARDS IS 1.                          *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE DATADG.                          *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*        THE COORDINATES IN THIS ITEM MUST BE SPECIFIED WITH           *
*      RESPECT TO THE ORIGIN OF THE DYNAMICS GRID.                     *
*                                                                      *
*                                                                      *
*      REPEAT THE FOLLOWING ITEM FOR M = 1,....,NDN.                   *
*                                                                      *
* 24.  ... XDN(M)          X COORDINATE OF THE M'TH DYNAMICS           *
*      .                   GRID GEOMETRY POINT, POSITIVE AFT,          *
*      .                   IN.                                         *
*      .                                                               *
*      .   YDN(M)          Y COORDINATE OF THE M'TH DYNAMICS           *
*      .                   GRID GEOMETRY POINT, POSITIVE TO            *
*      .                   THE LEFT, IN.                               *
*      .                                                               *
*      .   ZDN(M)          Z COORDINATE OF THE M'TH DYNAMICS           *
*      .                   GRID GEOMETRY POINT, POSITIVE UP,           *
*      ...                 IN.                                         *
*                                                                      *
*      FORMAT = (3E12.4).  NUMBER OF CARDS IS NDN.                     *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE DATADG.                          *
*                                                                      *
************************************************************************
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*      2.  CORRESPONDENCE TABLE                                          *
*          ------------------------                                      *
*                                                                        *
**************************************************************************
*                                                                        *
* 25.  ... TAC3              IDENTIFIES THE BEGINNING OF THE             *
*       .                    CARD INPUT DATA TO THE                      *
*       .                    TRANSFORMATIONS BETWEEN DYNAMICS            *
*       .                    AND STRUCTURES GRIDS SUBMODULE, IN          *
*       .                    THE AUTOMATED TRANSFORMATION                *
*       .                    ANALYSIS MODULE (ATAM). MUST BE             *
*      ...                   ENTERED AS SHOWN.                           *
*                                                                        *
*      USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE           *
*      AND PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT             *
*      THE END OF EACH EXECUTION.  REMAINING COLUMNS (FIVE TO            *
*      SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION          *
*      THE USER WISHES TO INCLUDE.                                       *
*                                                                        *
*      ------------                                                      *
*      |0000000001|                                                      *
*      |1234567890|                                                      *
*      ------------                                                      *
*      |TAC3|     |                                                      *
*      ------------                                                      *
*                                                                        *
*      FORMAT = (1A4).  NUMBER OF CARDS IS 1.                            *
*                                                                        *
*      DATA ARE ENTERED BY SUBROUTINE S2 AND SUBROUTINE LDB              *
*      WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE           *
*      PROPER HEADING FOR THE TABLE OF CONTENTS.                         *
*                                                                        *
**************************************************************************
*                                                                        *
*      SINCE THE SIGN CONVENTION FOR THE DYNAMICS MODEL AND THE          *
*      STRUCTURES MODEL IS NOT THE SAME, THE UNIT FORCES AND             *
*      MOMENTS IN THE DYNAMICS GRID ARE TRANSFORMED INTERNALLY           *
*      TO PROVIDE A CONSISTENT SIGN CONVENTION FOR THE FLUTTER           *
*      ANALYSIS.                                                         *
*                                                                        *
*                                                                        *
* 26.  ... NIGEOC            NUMBER OF DYNAMICS GRID POINTS IN           *
*       .                    THE CORRESPONDENCE TABLE BETWEEN            *
*       .                    THE DYNAMICS AND STRUCTURES GRIDS.          *
*       .                    SAME AS NON IN ITEM 23.                     *
*       .                                                                *
*       .  NDOF ≤ 200        NUMBER OF DYNAMICS GRID DEGREES OF          *
*       .                    FREEDOM (UNIT FORCE AND MOMENT              *
*       .                    INPUTS).  FOR EACH DYNAMICS GRID            *
*       .                    POINT A MAXIMUM OF SIX DEGREES OF           *
*       .                    FREEDOM MAY BE COUNTED - THREE FOR          *
*       .                    THE X, Y, Z FORCE COMPONENTS AND            *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*      .                    THREE FOR THE X, Y, Z MOMENT            *
*      .                    COMPONENTS.  THIS NUMBER WILL           *
*      .                    DEPEND ON THE VALUES OF NCORR(K), K     *
*      .                    = 7,...,12, I = 1,...,NIGEOC,           *
*      .                    ENTERED AS DATA IN THE ITEM BELOW.      *
*      .                                                            *
*      .   NSGEOU≤50        NUMBER OF STRUCTURES NODES TO WHICH     *
*      .                    UNIT BEAMING IS APPLIED. NOTE THAT      *
*      .                    A STRUCTURAL NODE TO WHICH UNIT         *
*      .                    BEAMING IS APPLIED CANNOT BE USED       *
*      .                    FOR SIMPLE OR CANTILEVER BEAMING.       *
*      .                                                            *
*      .   NIGEOL≤NIGEOC    LOWER VALUE OF DYNAMICS GRID POINT      *
*      .                    FOR WHICH INTERMEDIATE OUTPUT IN        *
*      .                    THE TRANSFORMATION ANALYSIS IS          *
*      .                    DESIRED.  IF KLUET(3) = 0, LET          *
*      .                    NIGEOL = 0.                             *
*      .                                                            *
*      .   NIGEOU≤NIGEOC    UPPER VALUE OF DYNAMICS GRID POINT      *
*      .                    FOR WHICH INTERMEDIATE OUTPUT IN        *
*      .                    THE TRANSFORMATION ANALYSIS IS          *
*      .                    DESIRED.  IF KLUET(3) = 0, LET          *
*      ...                  NIGEOU = 0.                             *
*                                                                   *
*      FORMAT (5I4).  NUMBER OF CARDS IS 1.                         *
*                                                                   *
*      DATA ARE ENTERED BY SUBROUTINE S2.                           *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
* 27. ... XREFT             X DISTANCE BETWEEN STRUCTURES AND       *
*      .                    DYNAMIC SURFACE COORDINATE SYSTEM       *
*      .                    ORIGINS, POSITIVE FOR DYNAMIC           *
*      .                    SURFACE AFT OF STRUCTURES               *
*      .                    COORDINATE SYSTEM, IN.                  *
*      .                                                            *
*      .   YREFT            Y DISTANCE BETWEEN STRUCTURES AND       *
*      .                    DYNAMIC SURFACE COORDINATE SYSTEM       *
*      .                    ORIGINS, POSITIVE FOR DYNAMIC           *
*      .                    SURFACE TO THE LEFT OF STRUCTURES       *
*      .                    COORDINATE SYSTEM, IN.                  *
*      .                                                            *
*      .   ZREFT            Z DISTANCE BETWEEN STRUCTURES AND       *
*      .                    DYNAMIC SURFACE COORDINATE SYSTEM       *
*      .                    ORIGINS, POSITIVE FOR DYNAMIC           *
*      .                    SURFACE ABOVE STRUCTURES COORDINATE     *
*      ...                  SYSTEM, IN.                             *
*                                                                   *
*      FORMAT = (4X, 3E13.6) NUMBER OF CARDS IS 1.                  *
*                                                                   *
*      DATA ARE ENTERED BY SUBROUTINE S2.                           *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*****************************************************************
*                                                               *
* 28. ... LOGIC ITEM            *** NO DATA ***                 *
*                                                               *
*      IF UNIT BEAMING IS INCLUDED (NSGEOU LARGER THAN ZERO)    *
*      ENTER THE FOLLOWING ITEM. OTHERWISE (NSGEOU = 0) OMIT    *
*      THIS ITEM.                                               *
*                                                               *
*****************************************************************
*                                                               *
*      ENTER (TEN VALUES OR LESS PER CARD) AND                  *
*      REPEAT THE FOLLOWING ITEM FOR I = 1,....,NSGEOU.         *
*                                                               *
*                                                               *
* 29. ... NODEUB(I)        ACTUAL STRUCTURAL NODE NUMBERS TO    *
*      .                   WHICH UNIT BEAMING IS APPLIED.       *
*      .                   THESE NUMBERS SHOULD BE THE SAME     *
*      .                   NUMBERS USED IN THE CORRESPONDENCE   *
*      ...                 TABLE BELOW.                         *
*                                                               *
*      FORMAT = (10I4). NUMBER OF CARDS IS (NSGEOU-1)/10 + 1.   *
*                                                               *
*      DATA ARE ENTERED BY SUBROUTINE S2.                       *
*                                                               *
*****************************************************************
*                                                               *
*      REPEAT THE FOLLOWING THREE ITEMS FOR I = 1.....NIGEOC    *
*                                                               *
*                                                               *
* 30. ... NCORR( 1)        THE NUMBER OF THE DYNAMIC NODE TO    *
*      .                   BE BEAMED TO THE STRUCTURAL NODES.   *
*      .                                                        *
*      .  NCORR( 2)        FIELD FOR STRUCTURES NODE I TO       *
*      .                   WHICH THE DYNAMIC NODE WILL BE       *
*      .                   BEAMED IN ACCORDANCE WITH THE        *
*      .                   BEAMING TYPE CLUE DESCRIBED BELOW    *
*      .                   (NCORR(6)).                          *
*      .                                                        *
*      .  NCORR( 3)        FIELD FOR STRUCTURES NODE J TO       *
*      .                   WHICH THE DYNAMIC NODE WILL BE       *
*      .                   BEAMED IN ACCORDANCE WITH THE        *
*      .                   BEAMING TYPE CLUE DESCRIBED BELOW    *
*      .                   (NCORR(6)).                          *
*      .                                                        *
*      .  NCORR( 4)        FIELD FOR STRUCTURES NODE K TO       *
*      .                   WHICH THE DYNAMIC NODE WILL BE       *
*      .                   BEAMED IN ACCORDANCE WITH THE        *
*      .                   BEAMING TYPE CLUE DESCRIBED BELOW    *
*      .                   (NCORR(6)).                          *
*      .                                                        *
*      .  NCORR( 5)        FIELD FOR STRUCTURES NODE L TO       *
*      .                   WHICH THE DYNAMIC NODE WILL BE       *
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

*     .                       BEAMED IN ACCORDANCE WITH THE           *
*     .                       BEAMING TYPE CLUE DESCRIBED BELOW       *
*     .                       (NCORR(6)).                             *
*     .                                                               *
*     .    NCORR( 6)          BEAMING TYPE CLUE.  THE FOUR TYPES      *
*     .                       OF BEAMING CLUES ALLOWED ARE            *
*     .                       DISCUSSED BELOW.  NOTE THAT THE         *
*     .                       SEQUENCE OF CALLOUT USING THE           *
*     .                       NUMBERED NODES IS ALWAYS IN A 'Z'       *
*     .                       PATTERN.                                *
*     .                                                               *
*     .                       1.  ORDERED SIMPLE BEAMING TO EIGHT     *
*     .                       NODES.  THE CLUE 'B' IN EITHER          *
*     .                       COLUMN 21 OR 22 (NOT IN BOTH)           *
*     .                       INDICATES ORDERED SIMPLE BEAMING TO     *
*     .                       EIGHT NODES.  THE FIRST BEAMING         *
*     .                       PLANE (TOP SURFACE) USES ODD            *
*     .                       NUMBERED NODES (I, J, K, AND L)         *
*     .                       PROVIDED BY THE USER.  THE SECOND       *
*     .                       BEAMING PLANE (BOTTOM SURFACE) USES     *
*     .                       EVEN NUMBERED NODES (N, O, P, AND       *
*     .                       Q) ASSIGNED BY THE PROGRAM.             *
*     .                                                               *
*     .                       2.  CANTILEVERED BEAMING TO FOUR        *
*     .                       NODES.  THE CLUE 'C' IN COLUMN 21       *
*     .                       OR 22 (NOT IN BOTH) INDICATES           *
*     .                       CANTILEVERED BEAMING TO FOUR NODES      *
*     .                       (I, J, K, AND L) PROVIDED BY USER.      *
*     .                                                               *
*     .                       3.  NON-ORDERED SIMPLE BEAMING TO       *
*     .                       EIGHT NODES.  THE CLUE '8B' IN          *
*     .                       COLUMNS 21 AND 22 INDICATES             *
*     .                       NON-ORDERED SIMPLE BEAMING TO EIGHT     *
*     .                       NODES (I, J, K, L, N, O, P, AND Q)      *
*     .                       PROVIDED BY THE USER.  NODES I, J,      *
*     .                       K, AND L SHOULD BE PUNCHED ON THIS      *
*     .                       CARD.  NODES N, O, P, AND Q SHOULD      *
*     .                       BE PUNCHED ON THE NEXT CARD AS          *
*     .                       SHOWN IN THE FOLLOWING ITEM.            *
*     .                       WHEN USING '8B' THERE IS NO             *
*     .                       RESTRICTION AS TO WHICH NODES ARE       *
*     .                       ODD AND WHICH ARE EVEN NUMBERED.        *
*     .                                                               *
*     .                       4.  UNIT BEAMING TO ONE NODE.  THE      *
*     .                       CLUE U IN COLUMN 21 OR 22 (NOT IN       *
*     .                       BOTH) INDICATES UNIT BEAMING TO         *
*     .                       NODE I (NODES J, K, AND L ARE EQUAL     *
*     .                       TO ZERO) PROVIDED BY THE USER.          *
*     .                                                               *
*     .    NCORR( 7) = 0      DO NOT INCLUDE EFFECT OF X FORCE        *
*     .                       COMPONENT IN THE DYNAMICS TO            *
*     .                       STRUCTURES GRID TRANSFORMATION          *
```

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ITEM      DATA                DESCRIPTION
----      ----                -----------

*         .                   MATRIX.                                  *
*         .             = 1   INCLUDE EFFECT OF X FORCE COMPONENT      *
*         .                   IN THE DYNAMICS TO STRUCTURES GRID       *
*         .                   TRANSFORMATION MATRIX.                   *
*         .                                                            *
*         .   NCORR( 8) = 0   DO NOT INCLUDE EFFECT OF Y FORCE         *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .             = 1   INCLUDE EFFECT OF Y FORCE COMPONENT      *
*         .                   IN THE DYNAMICS TO STRUCTURES GRID       *
*         .                   TRANSFORMATION MATRIX.                   *
*         .                                                            *
*         .   NCORR( 9) = 0   DO NOT INCLUDE EFFECT OF Z FORCE         *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .             = 1   INCLUDE EFFECT OF Z FORCE COMPONENT      *
*         .                   IN THE DYNAMICS TO STRUCTURES GRID       *
*         .                   TRANSFORMATION MATRIX.                   *
*         .                                                            *
*         .   NCORR(10) = 0   DO NOT INCLUDE EFFECT OF X MOMENT        *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .             = 1   INCLUDE EFFECT OF X MOMENT               *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .                                                            *
*         .   NCORR(11) = 0   DO NOT INCLUDE EFFECT OF Y MOMENT        *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .             = 1   INCLUDE EFFECT OF Y MOMENT               *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .                                                            *
*         .   NCORR(12) = 0   DO NOT INCLUDE EFFECT OF Z MOMENT        *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .             = 1   INCLUDE EFFECT OF Z MOMENT               *
*         .                   COMPONENT IN THE DYNAMICS TO             *
*         .                   STRUCTURES GRID TRANSFORMATION           *
*         .                   MATRIX.                                  *
*         .                                                            *
*         .   THETAZ          SWEEP ANGLE OF THE DYNAMICS GRID Y       *
*         .                   AXIS. POSITIVE FOR THE DYNAMICS          *
*         .                   GRID Y-AXIS SWEPT AFT OF THE             *
*         .                   STRUCTURAL Y-AXIS. DEG.  FOR THOSE       *
```

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ITEM      DATA              DESCRIPTION
----      ----              -----------

*      .                    NODES WHICH HAVE NO SWEEP, THE          *
*      ...                  FIELD MAY BE LEFT BLANK.                *
*                                                                   *
*      NOTE THAT THE SUM OF ONES (NCORR(K), K = 7,....,12.  I =     *
*      1.....NIGEOC) MUST BE EQUAL TO THE VALUE OF THE VARIABLE     *
*      NDOF ENTERED AS DATA IN ITEM 26.                             *
*                                                                   *
*      FORMAT = (5I4,A2,6I2,F6.2). NUMBER OF CARDS IS ONE FOR       *
*      EACH DYNAMICS GRID POINT.                                    *
*                                                                   *
*      DATA ARE ENTERED BY SUBROUTINE S2.                           *
*                                                                   *
*********************************************************************
*                                                                   *
* 31. ... LOGIC ITEM           *** NO DATA ***                      *
*                                                                   *
*      IF BEAMING TYPE CLUE (NCORR(6)) IS 'BB' ENTER THE            *
*      FOLLOWING ITEM, OTHERWISE IF BEAMING TYPE CLUE IS 'B',       *
*      'C', OR 'U' OMIT THIS ITEM.                                  *
*                                                                   *
*********************************************************************
*                                                                   *
* 32. ... NCORR(13)         FIELD FOR STRUCTURES NODE N TO          *
*      .                    WHICH THE DYNAMIC NODE WILL BE          *
*      .                    BEAMED IN ACCORDANCE WITH THE           *
*      .                    BEAMING TYPE CLUE DESCRIBED IN ITEM     *
*      .                    ABOVE (NCORR(6)).                       *
*      .                                                            *
*      .   NCORR(14)        FIELD FOR STRUCTURES NODE O TO          *
*      .                    WHICH THE DYNAMIC NODE WILL BE          *
*      .                    BEAMED IN ACCORDANCE WITH THE           *
*      .                    BEAMING TYPE CLUE DESCRIBED IN ITEM     *
*      .                    ABOVE (NCORR(6)).                       *
*      .                                                            *
*      .   NCORR(15)        FIELD FOR STRUCTURES NODE P TO          *
*      .                    WHICH THE DYNAMIC NODE WILL BE          *
*      .                    BEAMED IN ACCORDANCE WITH THE           *
*      .                    BEAMING TYPE CLUE DESCRIBED IN ITEM     *
*      .                    ABOVE (NCORR(6)).                       *
*      .                                                            *
*      .   NCORR(16)        FIELD FOR STRUCTURES NODE Q TO          *
*      .                    WHICH THE DYNAMIC NODE WILL BE          *
*      .                    BEAMED IN ACCORDANCE WITH THE           *
*      .                    BEAMING TYPE CLUE DESCRIBED IN ITEM     *
*      ...                  ABOVE (NCORR(6)).                       *
*                                                                   *
*      FORMAT = (4X,4I4). NUMBER OF CARDS IS ONE FOR EACH           *
*      DYNAMICS GRID POINT.                                         *
*                                                                   *
*      DATA ARE ENTERED BY SUBROUTINE S2.                           *
*                                                                   *
*********************************************************************
```

OUTPUT

MAIN PROGRAM (SOP)

THE MAIN PROGRAM CONTROLS THE LISTING OF THE FOUR ITEMS DISCUSSED BELOW. WHEREAS THE FIRST ITEM APPEARS AT THE VERY BEGINNING OF THE OUTPUT, THE OTHER THREE ITEMS APPEAR AT THE VERY END OF THE OUTPUT.

PROGRAM LISTING OF CARD DATA

THIS ITEM CONSISTS OF CARD IMAGES (COLUMS 1 TO 80) OF ALL THE INPUT DATA SUPPLIED TO THE CURRENT RUN. TO FACILITATE INSPECTION OF THIS DATA, A SEQUENTIAL CARD NUMBER IS ASSOCIATED WITH EACH CARD IMAGE.

INPUT-OUTPUT MATRIX LABELS AS GENERATED WITHIN THE PROGRAM

THIS ITEM, WHICH IS OPTIONAL OUTPUT, SUMMARIZES ALL THE CALLS TO SUBROUTINES 'GEDLAB', 'PUDLAB', 'GEFLAB', AND 'PUFLAB' IN THE ORDER IN WHICH THEY OCCURRED WITHIN THE RUN. SUBROUTINES 'GEDLAB' AND 'PUDLAB' RESPECTIVELY READ AND WRITE LABELS OF FILES (PERMANENT OR SCRATCH) STORED ON DSIO UNITS. SIMILARLY, 'GEFLAB' AND 'PUFLAB' RESPECTIVELY READ AND WRITE LABELS (IF ANY) OF FILES (PERMANENT OR SCRATCH) STORED ON FSIO UNITS. ALTHOUGH THIS SUMMARY SERVES MAINLY AS A DEBUGGING AID, IT IS ALSO A QUICK REFERENCE TO ASCERTAIN THE LOCATION, NAME, AND SIZE OF ANY MATRIX OF INTEREST.

THE FOLLOWING QUANTITIES ARE PRESENTED FOR EACH CALL.

(CALLING PROGRAM) - THIS IS THE SUBROUTINE IN WHICH THE CALL ORIGINATED.

(CALLED PROGRAM) - THIS IS THE NAME OF THE CALLED SUBROUTINE. IT IS EITHER 'GEDLAB', 'PUDLAB', 'GEFLAB', OR 'PUFLAB'.

(UNIT NAME) - THIS QUANTITY IS NOT CURRENTLY USED.

(FILE NAME) - THIS IS THE NAME OF THE MATRIX, PSEUDO-MATRIX, OR OTHER DATA IN THE FILE.

(UNIT) - THIS IS THE LOGICAL UNIT ON WHICH THE DATA RESIDES.

(FILE) - THIS IS THE LOCATION OF THE DATA ON THE UNIT.

(ROWS, COLS) - IF THE FILE CONTAINS A MATRIX OR PSEUDO-MATRIX, THESE TWO QUANTITIES USUALLY DEFINE THE ACTUAL SIZE OF THE ARRAY. HOWEVER, IF THE SIZE IS NOT KNOWN PRIOR TO THE FORMATION OF THE ARRAY, OR IF THE DATA IS NOT IN THE FORM OF AN ARRAY, THESE TWO QUANTITIES ARE USED WITHIN THE PROGRAM BUT ARE OF NO INTEREST TO THE USER.

(PAGE) - THE OUTPUT HAD REACHED THIS PAGE OF THE LISTING WHEN THE CALL WAS MADE.

INPUT-OUTPUT MATRIX LABELS IN NUMERICAL ORDER OF I/O UNITS

THIS ITEM, WHICH IS ALSO OPTIONAL OUTPUT, IS IDENTICAL TO THE PREVIOUS ITEM EXCEPT THAT THE CALLS ARE ORDERED ACCORDING TO I/O UNIT RATHER THAN IN THE ORDER IN WHICH THEY WERE EXECUTED. THIS SUMMARY SERVES AS A QUICK REFERENCE TO DETERMINE THE DATA STORED ON ANY PARTICULAR UNIT.

TABLE OF CONTENTS

A TABLE OF CONTENTS IS SUPPLIED TO AID THE USER IN LOCATING SOME MAJOR OUTPUT ITEMS IN THE LISTING.

ALAM - AUTOMATED LOAD ANALYSIS MODULE

AND

ATAM - AUTOMATED TRANSFORMATION ANALYSIS MODULE

IN SOP, CONTROL PASSES FROM ALAM TO ATAM AND THEN BACK TO ALAM AGAIN. ACCORDINGLY, THE OUTPUT ITEMS OF ATAM ARE NESTED WITHIN THE OUTPUT ITEMS OF ALAM. THE OUTPUT ITEMS OF THESE TWO MODULES ARE PRESENTED IN THE FOLLOWING MATERIAL.

ALAM ITEM - GEOMETRY OF AERODYNAMICS MODEL

A COMPLETE DESCRIPTION OF THE GEOMETRIC PROPERTIES OF THE AERODYNAMICS MODEL, INCLUDING AERODYNAMIC PANEL DIMENSIONS, AREAS, COORDINATES, ETC., WITH SELF-EXPLANATORY TITLES. AERODYNAMIC PANELS ARE NUMBERED FROM LEADING TO TRAILING EDGE STARTING AT THE TIP. PANEL NUMBER IS DENOTED BY INDEX I. THE ORIGIN FOR SPANWISE (Y) COORDINATES IS COINCIDENT WITH THE CENTER OF THE CIRCULAR CYLINDER WHICH AERODYNAMICALLY REPRESENTS THE FUSELAGE. THE ORIGIN OF THE STREAMWISE (X) AXIS COINCIDES WITH THE INTERSECTION OF THE SURFACE LEADING EDGE AND FUSELAGE SIDE (SEE FIGURE 1, ALAM USERS MANUAL). WHEN THE FUSELAGE IS NOT AERODYNAMICALLY REPRESENTED (R=.001), THE ORIGIN FOR BOTH COORDINATES IS COINCIDENT WITH THE INTERSECTION OF THE SURFACE LEADING EDGE AND THE ROOT CHORD. ALL PANEL GEOMETRY IS ASSUMED TO BE IN THE Z=0 PLANE.

ALAM ITEM - AERODYNAMIC INFLUENCE COEFFICIENT (AIC) MATRICES

AERODYNAMIC INFLUENCE COEFFICIENT MATRICES RELATING PANEL PRESSURES TO ANGLE OF ATTACK, PER UNIT OF FREE-STREAM DYNAMIC PRESSURE. DISPLAYED FOR EACH OF THE DIFFERENT MACH NUMBERS INCLUDED IN THE SPECIFIED FLIGHT CONDITIONS.

ALAM ITEM - ACCELERATIONS IN WEIGHTS GRID

COMPUTED COMPONENTS OF LINEAR ACCELERATION (FT/SEC**2) AT CENTER OF GRAVITY OF EACH MASS ITEM. DATA IS PRESENTED FOR EACH FLIGHT CONDITION. THE TOTAL NUMBER OF ROWS OF OUTPUT CORRESPONDS TO THE TOTAL NUMBER OF DISTRIBUTED MASSES (NO INERTIA

PROPERTIES) AND CONCENTRATED MASSES (INCLUDING INERTIA PROPERTIES) SPECIFIED AS INPUT DATA. THE DISTRIBUTED MASS COMPONENTS PRECEDE THE CONCENTRATED MASS COMPONENTS IN THE ROW SEQUENCE.

ALAM ITEM - INERTIAL FORCES IN WEIGHTS GRID

COMPUTED INERTIAL FORCES CORRESPONDING TO COMPUTED ACCELERATIONS IN PRECEDING ITEM.

ALAM ITEM - INERTIAL MOMENTS IN THE WEIGHTS GRID

COMPUTED COMPONENTS OF INERTIAL MOMENT AT THE CENTER OF GRAVITY OF EACH CONCENTRATED MASS, DISPLAYED FOR EACH FLIGHT CONDITION. SINCE THIS DATA ITEM ONLY APPLIES TO CONCENTRATED MASSES, THE NUMBER OF ROWS OF OUTPUT IS EQUAL TO THE NUMBER OF CONCENTRATED MASSES.

ATAM ITEM - COORDINATES OF STRUCTURES MODEL NODE POINTS

THE X, Y, AND Z COORDINATES OF EACH STRUCTURAL NODE ARE LISTED, (XSGEO,YSGEO,ZSGEO), WHERE THESE COORDINATES ARE DEFINED WITH RESPECT TO THE STRUCTURES MODEL COORDINATE SYSTEM. IT WILL BE NOTED THAT 'ROW' PROVIDES A SEQUENTIAL COUNT OF NODE GEOMETRY INPUT, WHEREAS 'NODE' INDICATES THE ACTUAL STRUCTURES NODE NUMBER DESIGNATED BY THE USER. NOTE THAT ALL SUBSEQUENT OUTPUT OF AERO AND INERTIAL LOAD COMPONENTS IN THE STRUCTURES GRID ARE IDENTIFIED BY 'ROW' NUMBER RATHER THAN 'NODE' NUMBER.

ATAM ITEM - TRANSFORMATION MATRICES FROM AERODYNAMICS, WEIGHTS, AND DYNAMICS GRIDS TO THE STRUCTURES GRID

THREE TRANSFORMATION TABLES ARE SHOWN, ALL OF WHICH HAVE THE SAME FORMAT. THE DATA PRESENTED INDICATES THE DISTRIBUTED FORCES AT STRUCTURES MODEL NODE POINTS DUE TO UNIT LOADS APPLIED AT THE INPUT NODES (AERODYNAMIC, WEIGHTS, OR DYNAMIC). THE 'ROW' NUMBER, WHICH APPEARS IN THE FIRST COLUMN OF THE TRANSFORMATION TABLE, IS IDENTICAL TO THE AERODYNAMIC PANEL NUMBER IN THE CASE OF AERODYNAMIC LOAD BEAMING. FOR INERTIA LOAD BEAMING IT REPRESENTS THE LOAD COMPONENT SEQUENCE NUMBER WHERE ALL SELECTED INERTIA LOAD COMPONENTS AT THE FIRST WEIGHTS NODE (FX,FY,FZ,MX,MY,MZ) ARE NUMBERED SEQUENTIALLY BEFORE PROCEEDING

TO THE NEXT NODE, ETC. FOR DYNAMIC LOAD BEAMING, THE ROW NUMBER IS IDENTICAL TO THE DYNAMIC DEGREE OF FREEDOM NUMBER. THE 'ROW' NUMBER IS FOLLOWED BY ALPHABETIC CHARACTERS DENOTING THE PARTICULAR APPLIED LOAD COMPONENT (FX,FY,FZ,MX,MY,MZ) AND THE ASSOCIATED INPUT NODE NUMBER. THE DATA ITEM ENTITLED 'COL' CAN BE IGNORED SINCE IT IS A NUMBERING SYSTEM INTERNAL TO THE PROGRAM. THE NEXT TWO DATA ITEMS, 'OUTPUT NODE' AND 'OUTPUT FOR UNIT INPUT', GIVE THE RESULTANT FORCE COMPONENT AT A STRUCTURES NODE (ALPHABETIC CHARACTERS AS INDICATED PREVIOUSLY), THE STRUCTURES NODE NUMBER, AND THE VALUE OF THE FORCE COMPONENT AT THAT STRUCTURES NODE. THIS DATA IS REPEATED FOR EVERY STRUCTURES NODE DESIGNATED FOR FORCE BEAMING OF THE PARTICULAR INPUT LOAD COMPONENT. THIS OUTPUT DATA IS REPEATED FOR EACH LOAD COMPONENT SPECIFIED FOR THE AERODYNAMIC, WEIGHTS, AND DYNAMICS MODELS.

ALAM ITEM - INERTIAL FORCES IN THE STRUCTURES GRID

THE INERTIAL FORCES AND MOMENT, DISTRIBUTED FROM THE CENTERS OF GRAVITY OF THE INDIVIDUAL MASS ITEMS TO THE NODE POINTS OF THE MODEL, ARE DISPLAYED FOR EACH FLIGHT CONDITION.

ALAM ITEM - GEOMETRY OF DISTRIBUTED AND CONCENTRATED MASSES IN THE WEIGHTS GRID

THE COORDINATES OF THE CENTERS OF GRAVITY OF THE MASS ITEMS SUPPLIED BY THE USER FOR INERTIAL LOAD CALCULATIONS. THE COORDINATES OF DISTRIBUTED MASSES PRECEDE THE COORDINATES OF CONCENTRATED MASSES.

ALAM ITEM - AERODYNAMIC SURFACE GEOMETRY

DIMENSIONS AND AREAS OF AERODYNAMIC PANELS.

ALAM ITEM - TOTAL ANGLE OF ATTACK

THE ANGLE OF ATTACK (RADIANS) OF EACH AERODYNAMIC PANEL (SPECIFIED BY THE USER) IS DISPLAYED FOR EACH FLIGHT CONDITION. IT IS NOTED THAT IF THE USER SPECIFIES A UNIFORM ANGLE OF ATTACK FOR THE SURFACE, THE INCLUSION OF A CYLINDRICAL FUSELAGE (FOR SUBSONIC FLOW ONLY) WILL RESULT IN A SPANWISE VARIATION IN NET SURFACE ANGLE OF ATTACK DUE TO THE INDUCED UPWASH EFFECT CREATED BY THE FUSELAGE.

ALAM ITEM - STREAMWISE DATA

SPANWISE VARIATION OF AERODYNAMIC SECTION PROPERTIES SUCH AS RUNNING LOAD AND LOCATION OF CENTER OF PRESSURE FOLLOWED BY A SUMMATION OF THE NET AERODYNAMIC FORCES AND MOMENTS (FX,FY,FZ,MX,MY,MZ) ABOUT THE ORIGIN OF THE AERODYNAMIC COORDINATE SYSTEM. THIS DATA ITEM IS REPEATED FOR EACH OF THE PRESCRIBED FLIGHT DESIGN LOAD CONDITIONS.

ALAM ITEM - PRESSURES IN THE AERC GRID

AERODYNAMIC PRESSURES ARE DISPLAYED FOR EACH FLIGHT CONDITION.

ALAM ITEM - FORCES IN THE AERODYNAMICS GRID

PRESSURES ARE INTEGRATED TO OBTAIN THE FORCES ACTING AT EACH PANEL CENTER.

ALAM ITEM - AERODYNAMIC FORCES IN THE STRUCTURES GRID

AERODYNAMIC FORCES DISTRIBUTED TO THE NODE POINTS OF THE STRUCTURES MODEL ARE DISPLAYED FOR EACH FLIGHT CONDITION.

ALAM ITEM - TOTAL FORCES IN THE STRUCTURES GRID

THESE FORCES REPRESENT THE SUMMATION OF AERODYNAMIC AND INERTIAL LOADS AFTER DISTRIBUTION TO THE STRUCTURES MODEL NODE POINTS. THEY ARE ALSO DISPLAYED FOR EACH FLIGHT CONDITION.

ASAM - AUTOMATED STRUCTURAL ANALYSIS MODULE

AND

ASOM - AUTOMATED STRUCTURAL OPTIMIZATION MODULE

IN SCP, CONTROL PASSES FROM ASAM TO ASOM AND THEN BACK TO ASAM AGAIN. ACCORDINGLY, THE OUTPUT ITEMS OF ASOM ARE NESTED WITHIN THE OUTPUT ITEMS OF ASAM. THE OUTPUT ITEMS OF THESE TWO MODULES ARE DISCUSSED BELOW.

ASAM ITEM - ALLOWABLE STRESS REDUCTION FACTORS

REDUCTION FACTORS ARE DISPLAYED FOR EACH OF THE PRESCRIBED DESIGN LOAD CONDITIONS.

ASAM ITEM - INPUT STRUCTURES GEOMETRY

'KARD' PROVIDES A SEQUENTIAL COUNT OF STRUCTURES NODE GEOMETRY (X,Y,Z) INPUT DATA. 'NODE' DENOTES THE ACTUAL STRUCTURES NODE NUMBER DESIGNATED BY THE USER. 'IBC' DENOTES THE SPECIFIED BOUNDARY CONDITIONS.

ASAM ITEM - BEAMING MATRIX (DYN. TO STR.) WITH BCS

IN THE DYNAMIC LOAD BEAMING MATRIX INITIALLY DISPLAYED AS OUTPUT FROM ATAM, THE LOADS IN THE STRUCTURES GRID WERE PRESENTED FOR EACH NODE AND EACH NODE LOAD DIRECTION. ON ENTERING ASAM, THAT LOAD BEAMING MATRIX IS TRANSFORMED BY THE STRUCTURAL BOUNDARY CONDITION MATRIX. THE RESULTING MATRIX MAY BE DISPLAYED AS OPTIONAL OUTPUT. THE 'ROW' NUMBER OF THE TRANSFORMED BEAMING MATRIX CORRESPONDS TO THE NUMBER OF THE STRUCTURAL DEGREE OF FREEDOM, AND THE 'COLUMN' NUMBER CORRESPONDS TO THE NUMBER OF THE DYNAMICS DEGREE OF FREEDOM.

ASAM ITEM - APPLIED LOADS

THIS IS A SUMMARY OF APPLIED LOAD CONDITIONS THAT HAVE BEEN

ENTERED AS CARD DATA IN ASAM (DOES NOT INCLUDE LOADS FROM ALAM).

ASAM ITEM - SUMMARY OF APPLIED LOADS

THE RESULTANT FORCE AND MOMENT (ABOUT THE ORIGIN OF THE STRUCTURES MODEL COORDINATES SYSTEM) ASSOCIATED WITH EACH OF THE CARD INPUT APPLIED LOAD CONDITIONS (SEE PREVIOUS ITEM) ARE LISTED. THIS IS FOLLOWED BY A TABULAR SUMMARY OF ALL DESIGN LOAD CONDITIONS FROM BOTH ALAM AND ASAM. IN THIS SUMMARY, BOTH THE STRUCTURAL NODE AND STRUCTURAL DEGREE OF FREEDOM NUMBER (NDOF) ASSOCIATED WITH EACH LOAD COMPONT ARE PRESENTED.

ASAM ITEM - MATERIAL PROPERTIES TABLE

THE MATERIAL CODES AND ASSOCIATED MATERIAL PROPERTIES ARE LISTED. THIS TABLE INCLUDES MATERIALS DATA WHICH ARE BUILT-IN TO THE PROGRAM AND ANY OTHER MATERIAL DATA SUPPLIED BY THE USER.

ASAM ITEM - MEMBER CARDS

THE USER-SUPPLIED MEMBER DATA IS LISTED.

ASAM ITEM - GEOMETRY AND BOUNDARY CONDITIONS

THE COORDINATES OF EACH STRUCTURES MODEL NODE AND THE DEGREE-OF-FREEDOM NUMBERS ASSOCIATED WITH THE NODE ARE LISTED. A NEGATIVE NUMBER OR A ZERO IN THE 'BOUNDARY CONDITIONS' SECTION OF THE TABLE INDICATES A FIXED (ZERO) DISPLACEMENT.

ASAM ITEM - MEMBER PROPERTIES

ALL THE DATA ITEMS ARE LISTED FOR EACH ELEMENT TYPE IN THE PROGRAM. NUMBERS IN PARENTHESES CORRESPOND TO NUMBERED ITEMS IN FIGURE 3 OF THE ASAM SECTION OF THE USERS MANUAL. THIS IS FOLLOWED BY A LIST OF ALL THE SPECIFIC DATA STORED FOR EACH ELEMENT IN THE STRUCTURES MODEL. THIS LIST IS USEFUL FOR CHECKING THAT ALL THE INPUT MEMBER DATA HAS BEEN PROPERLY STORED WITHIN THE PROGRAM (AS WHEN DEBUGGING).

ASAM ITEM - BANDWIDTH

AFTER THE MEMBER PROPERTIES LIST, A MESSAGE APPEARS WHICH INDICATES THE TOTAL NUMBER OF STRUCTURAL MEMBERS (ELEMENTS) CONTRIBUTING TO THE STRUCTURAL STIFFNESS MATRIX, AND THE BANDWIDTH OF THAT MATRIX.

ASOM ITEM - FORCE DIRECTION TABLE

THE DIRECTION AND FORCE NUMBER ARE GIVEN FOR EACH OF THE SUMMED INTERNAL FORCES (CAP FORCES).
NOTE - A TABLE OF CAP FORCES FOR THE OPTIMIZED DESIGN APPEARS AT A LATER POINT IN THE OUTPUT. IN THAT TABLE, THE 'FORCE NUMBER' IS REFERRED TO AS 'ROW NUMBER'.

ASOM ITEM - PREDICTED FSD AREAS FOR NEXT CYCLE

EACH CYCLE OF REDESIGN IS ACCOMPLISHED BY FIRST ANALYZING THE STRUCTURE (TO COMPUTE STRESS RATIOS) AND THEN RESIZING THE STRUCTURE. THIS ITEM LISTS THE 'MEMBER' (ELEMENT) NUMBER AND THE ASSOCIATED 'AREA' (THICKNESS OR AREA DEPENDING ON THE TYPE OF ELEMENT) OF EACH ELEMENT FOLLOWING A RESIZING. SINCE THE FINAL OPTIMIZED STRUCTURE IS ALSO ANALYZED, AN 'EXTRA' APPARENT RESIZING OF THE FINAL STRUCTURE IS SHOWN IN THE OUTPUT. NOTE THAT THE GAGES APPEARING IN THIS 'EXTRA' TABLE REFLECT A DESIGN ONE CYCLE BEYOND THE FINAL DESIGN. THUS, IF N CYCLES OF REDESIGN ARE CALLED FOR, N+1 TABLES OF RESIZED GAGES WILL BE SHOWN BUT THE LAST TABLE IS IGNORED.

ASOM ITEM - NEW WEIGHT AND STRESS CONSTRAINT RATIO

THIS DATA, WHICH APPEARS IMMEDIATELY AFTER EACH OF THE TABLES DESCRIBED IN THE PREVIOUS ITEM, DEFINES THE WEIGHT AND MAXIMUM STRESS RATIO OF THE STRUCTURE THAT WAS ANALYZED - BEFORE RESIZING. ACCORDINGLY, THE FIRST TIME THIS ITEM APPEARS THE 'NEW WEIGHT' IS ACTUALLY THE INITIAL WEIGHT OF THE STRUCTURES MODEL.
NOTE - NON-OPTIMUM FACTORS AND ADDITIONAL MASS ITEMS SPECIFIED IN FOP (SUCH AS MASS BALANCES) ARE NOT INCLUDED IN THIS WEIGHT SUMMARY.

****
***** THE REMAINING ITEMS PERTAIN TO THE DESIGN AFTER THE
***** DESIRED NUMBER OF RESIZING CYCLES, I.E., THE FINAL DESIGN.
****

ASAM ITEM - NODAL DEFLECTIONS

THE DEFLECTIONS AT EACH STRUCTURAL NODE ARE LISTED. EACH ROW CORRESPONDS TO A DISPLACEMENT COMPONENT, AND EACH COLUMN CORRESPONDS TO A LOADING CONDITION.

ASAM ITEM - CAP FORCES

THIS TABLE PROVIDES INFORMATION ON INTERNAL FORCES (DENOTED BY 'F') AND STRESSES (DENOTED BY 'S') OBTAINED BY SUMMING ELEMENT FORCES AT A PARTICULAR NODE IN THE DIRECTION OF STRAIGHT LINES JOINING THAT NODE TO ADJACENT NODES. THE NUMBER PRECEDING 'F' OR 'S' DENOTES THE LOAD CONDITION. FOLLOWING EACH CAP FORCE, THE DIRECTION COSINES OF THE FORCE WITH RESPECT TO THE STRUCTURAL COORDINATE AXES ARE INDICATED (DX,DY,DZ).

ASAM ITEM - ELEMENT STRESSES

THE SPECIFIC INFORMATION PRINTED OUT FOR THIS ITEM DEPENDS UPON THE ELEMENT TYPE. HOWEVER, ALL ELEMENT PRINT-OUTS START WITH ELEMENT NUMBER, TYPE, CONNECTING NODES, THICKNESS OR AREA (LABELLED THICKNESS), AND MATERIAL CODE. ADDITIONAL INFORMATION COMMON TO ALL ELEMENTS IS THE IDENTIFICATION OF THE CRITICAL LOADING CONDITION AND THE RATIO OF THE EFFECTIVE STRESS TO ALLOWABLE STRESS AT EACH OF THE CONNECTING NODES OF THE ELEMENT (LABELLED 'STRESS RATIO FOR NEXT CYCLE'). THE DESIGN CRITERION IS ALSO INCLUDED (LABELLED 'DESIGN BY YIELD, STABILITY, OR SIZE').

ASAM ITEM - SHEAR FLOWS

COMPLETE EDGE SHEAR FLOW (DENOTED BY 'Q') AND SHEAR STRESS (DENOTED BY 'S') INFORMATION FOR ALL MEMBRANE ELEMENTS IS PRINTED OUT. THE EDGE SHEAR FLOWS ARE OBTAINED BY TAKING DIFFERENCES OF ELEMENT NODAL FORCES, AND DIFFER FROM THE EDGE SHEARS LISTED IN THE PRECEDING ITEM. THE FORMAT IS SIMILAR TO THAT FOR CAP FORCES. THIS INFORMATION IS FOLLOWED BY THE LENGTH OF THE SIDE ON WHICH THE SHEAR IS ACTING.

ASAM ITEM - BEAM ELEMENT DATA

THIS ITEM CONTAINS FURTHER DETAILS OF INTERNAL LOADS ACTING ON BEAM ELEMENTS. FIRST THE ELEMENT NUMBER AND THE CONNECTING

NODES ARE LISTED, FOLLOWED BY THE TRANSVERSE SHEARS VY AND VZ, AT EACH END OF THE BEAM ELEMENT IN ITS LOCAL AXIS SYSTEM. THIS IS REPEATED FOR EACH LOAD CONDITION. THE LOADING CASES FOR MAXIMUM AND MINIMUM VALUES ARE ALSO INDICATED. THIS SET OF DATA IS REPEATED FOR MX (TWISTING MOMENT), MY, AND MZ.

ASAM ITEM - FINAL SIZES

FOR EACH ELEMENT, THE MEMBER NUMBER, FINAL THICKNESS OR AREA (LABELLED AREA), AND WEIGHT ARE LISTED.

ASAM ITEM - DYNAMIC FLEXIBILITY MATRIX OR STIFFNESS MATRIX

THE DYNAMIC FLEXIBILITY MATRIX OR STRUCTURAL STIFFNESS MATRIX TO BE USED FOR VIBRATION ANALYSIS IN FOP (AVAM) IS LISTED.

ASAM ITEM - STRUCTURAL RIGID-BODY TRANSFORMATION MATRIX

THIS MATRIX, DENOTED AS 'STR LAMT', APPEARS IN A FIRST SOP PASS WHEN FREE-FREE VIBRATION MODES ARE TO BE COMPUTED IN FOP. THIS MATRIX DEFINES THE DISPLACEMENTS OF ALL STRUCTURAL DEGREES OF FREEDOM FOR UNIT RIGID-BODY MOTION. THE ROW NUMBER CORRESPONDS TO THE SPECIFIC RIGID-BODY MODE AND THE COLUMN NUMBER CORRESPONDS TO THE STRUCTURAL DEGREE OF FREEDOM.

ASAM ITEM - DYNAMIC RIGID-BODY TRANSFORMATION MATRIX

THIS MATRIX, DENOTED AS 'DYN LAMT', IS SIMILAR TO THE MATRIX DISCUSSED IN THE PREVIOUS ITEM EXCEPT THAT THE DISPLACEMENTS ARE PRESCRIBED FOR DYNAMIC DEGREES OF FREEDOM RATHER THAN STRUCTURAL DEGREES OF FREEDOM. NOTE THAT THIS MATRIX WILL NOT APPEAR IF THE 'STIFFNESS' APPROACH IS TAKEN, I.E., IF THE STRUCTURAL AND DYNAMIC DEGREES OF FREEDOM ARE IDENTICAL.

PART C

USAGE/INPUT/OUTPUT FOR FLUTTER OPTIMIZATION PROGRAM (FOP)

USAGE

MAIN PROGRAM (FOP)

I. PROGRAM APPLICATION

A. FORMATS

THE FORMATS USED FOR INPUT DATA TO THE PROGRAM DESCRIBED HEREIN ARE EXPLAINED BRIEFLY BELOW. IN GENERAL, THE VALUE OF THE VARIABLE IS PUNCHED FIRST ON A CARD, AND THE REMAINING COLUMNS MAY BE USED TO IDENTIFY THE VARIABLE BY MEANS OF EITHER FORTRAN SYMBOLS OR A WORD DESCRIPTION.

A FORMAT 1E12.3 INDICATES THAT THE VARIABLE IS USUALLY KEYPUNCHED IN COLUMNS 3-12 OF THE CARD (RIGHT JUSTIFIED) IN THE FOLLOWING MANNER. -X.XXXE-YY, WHERE THE NUMBER IS -X.XXX TIMES 10**-YY. IF MORE DIGITS ARE REQUIRED THE NUMBER MAY BE PUNCHED ON THE CARD AS -X.XXXXXE-YY, -X.XXXXXXE-Y, OR -X.XXXXXXX-Y. A FORMAT 2E12.3, INDICATES THAT THE VALUES OF TWO VARIABLES ARE TO BE PUNCHED ON THE SAME CARD. THE FIRST IN COLUMNS 3-12 AND THE SECOND IN COLUMNS 15-24.

A FORMAT F10.3 INDICATES THAT THE VARIABLE IS USUALLY PUNCHED IN COLUMNS 3-10 OF THE CARD AS FOLLOWS -XXX.XXX.

A FORMAT I4 INDICATES THAT AN INTEGER OF FOUR OR LESS DIGITS IN COLUMNS 1-4 IS PUNCHED WITH THE UNITS DIGIT ALWAYS AT THE EXTREME RIGHT OF THE FIELD. A GENERALIZATION OF THIS FORMAT, KI4, WHERE K IS ASSIGNED ANY VALUE BETWEEN TWO AND EIGHTEEN, DENOTES K GROUPS OF A MAXIMUM OF FOUR INTEGERS EACH IN COLUMNS 1-4, 5-8,...., 69-72, RESPECTIVELY.

THE FORMAT 72H REFERS TO CARDS OF IDENTIFICATION (TITLES), AND INDICATES THAT ANY ALPHAMERIC CHARACTER MAY BE PUNCHED IN COLUMNS 1-72.

A COMBINED FORMAT SUCH AS 1E12.3, 60H DENOTES THAT THE VARIABLE IN THE FIRST 12 COLUMNS IS TO BE FOLLOWED BY UP TO 60 COLUMNS OF ALPHAMERIC CHARACTERS. A FORMAT 2X IN THE MIDDLE OF THIS COMBINED FORMAT, PROVIDES FOR TWO BLANK SPACES BETWEEN THE NUMBER AND ITS DESCRIPTION.

FINALLY, A FORMAT A4 IS USED TO STORE ALPHAMERIC INFORMATION IN FORTRAN VARIABLES IN THE FORM OF FOUR CHARACTERS PER WORD. THIS FORMAT IS USED FOR WRITING AND/OR PLOTTING CERTAIN ALPHAMERIC INFORMATION.

A LIST OF THE INPUT DATA FOR THE ILLUSTRATIVE EXAMPLES IS GIVEN IN VOLUME VII.

B. ARRANGEMENT OF DATA ON CARDS

THE INPUT DATA TO BE ENTERED ON CARDS ARE DESCRIBED IN CONSECUTIVELY NUMBERED GROUPS CALLED 'ITEMS'. ALL THE VARIABLES SUMMARIZED UNDER THE SAME ITEM ARE PUNCHED CONSECUTIVELY ON THE SAME CARD OR GROUP OF CARDS USING THE INDICATED FORMAT. IN THE CASE OF SUBSCRIPTED VARIABLES THE INSTRUCTIONS 'REPEAT' AND 'ENTER' ARE USED WITH THE ASSOCIATED INDICES TO INDICATE THE ORDER IN WHICH THE INPUT DATA IS PUNCHED ON CARDS. THE INSTRUCTION 'REPEAT' REQUIRES ANOTHER CARD OR GROUP OF CARDS FOR EACH COMBINATION OF INDICES, WHEREAS THE INSTRUCTION 'ENTER' INDICATES THAT THE VALUES OF THE VARIABLES ARE PUNCHED ON THE SAME CARD AND ANY CONTINUATION CARDS REQUIRED TO COVER THE INDICATED RANGE OF INDICES. THESE TWO INSTRUCTIONS MAY BE REPEATED A NUMBER OF TIMES, WITH THE TOPMOST INSTRUCTION DESIGNATING THE STEP TO BE EXECUTED LAST. FOR EXAMPLE, THE FOLLOWING COMBINATION OF TWO INSTRUCTIONS AND ASSOCIATED FORMAT,

```
        REPEAT THE FOLLOWING ITEM FOR I = 1,...., IMAX(=2),
        REPEAT THE FOLLOWING ITEM FOR J = 1,...., JMAX(=3), AND
        ENTER (FOUR VALUES OR LESS PER CARD) FOR K = 1,....,KMAX(=3)

X.  *** A(I,J,K) (DEFINITION)
    *
    *** B(I,J,K) (DEFINITION)
        ---------------------------------------------------
        |00000000011111111112222222222333333333344444444445|
        |12345678901234567890123456789012345678901234567890|
        ---------------------------------------------------
        |     . E |     . E |     . E |     . E | A, B(I,J,K)|
        ---------------------------------------------------

        FORMAT = (4E9.2).  NUMBER OF CARDS IS
        IMAX * JMAX * ((KMAX-1)/2 + 1)  (=12).
```

WILL REQUIRE THE INPUT DATA PUNCHED ON CARDS AS FOLLOWS

.E	.E	.E	.E	A, B(1,1,K), K=1,2
.E	.E			A, B(1,1,K), K=3,3
.E	.E	.E	.E	A, B(1,2,K), K=1,2
.E	.E			A, B(1,2,K), K=3,3
.E	.E	.E	.E	A, B(1,3,K), K=1,2
.E	.E			A, B(1,3,K), K=3,3
.E	.E	.E	.E	A, B(2,1,K), K=1,2
.E	.E			A, B(2,1,K), K=3,3
.E	.E	.E	.E	A, B(2,2,K), K=1,2
.E	.E			A, B(2,2,K), K=3,3
.E	.E	.E	.E	A, B(2,3,K), K=1,2
.E	.E			A, B(2,3,K), K=3,3

MORE SPECIFICALLY THE FIRST DATA CARD CONSISTS OF A(1,1,1), B(1,1,1), A(1,1,2), AND B(1,1,2), AND THE TWELFTH CARD CONTAINS A(2,3,3) AND B(2,3,3).

SINCE INTEGER DIVISION TRUNCATES A QUOTIENT HAVING A FRACTIONAL PART TO THE NEXT SMALLER INTEGER, THE FRACTION (KMAX-1)/2 IS TO BE INTERPRETED AS THE 'LOWEST INTEGER VALUE'. THUS, IF KMAX WERE EQUAL TO 4 INSTEAD OF 3 AS IN THE ABOVE EXAMPLE, IMAX*JMAX*((KMAX-1)/2 + 1) WOULD STILL BE EQUAL TO 12, SINCE ((KMAX-1)/2 + 1) = 1.5 + 1 = 1 + 1 = 2.

AVAM - AUTOMATED VIBRATION ANALYSIS MODULE

I. PROGRAM APPLICATION

A. MASS (WEIGHTS, UNBALANCES, AND INERTIAS)

THE MASS MATRIX IS ENTERED FOR AS MANY DEGREES OF FREEDOM AS PROVIDED IN THE FLEXIBILITY MATRIX CALCULATION OR THE STIFFNESS MATRIX CALCULATION. THE MASS MATRIX MUST BE CONSISTENT WITH THE FLUTTER COORDINATE SYSTEM SIGN CONVENTION DEPICTED IN FIGURE 9 (ATAM). SINCE THE MASS MATRIX IS SYMMETRICAL, DATA FOR THE LOWER TRIANGLE ONLY WILL BE ENTERED. THE FINAL MASS MATRIX WILL BE MADE UP OF ALL THE DEGREES OF FREEDOM STORED SEQUENTIALLY IN ROW SORT IN THE VARIABLE PMASS(I). WITH EACH ELEMENT OF THE MASS MATRIX, THE ROW AND COLUMN NUMBER ASSOCIATED WITH THAT ELEMENT WILL ALSO BE ENTERED AS DATA. UNDER THIS PROCEDURE, ONLY THOSE ELEMENTS WITH NON-ZERO VALUES NEED TO BE ENTERED AS DATA.

B. MODAL DATA

AVAM WILL COMPUTE AS MANY AS 20 NORMAL MODES OF VIBRATION IN A SINGLE ANALYSIS. THE DEGREES OF FREEDOM OF THE VIBRATION MODEL SHOULD NOT EXCEED 200. THE DEFLECTION ARRAYS CORRESPONDING TO THE VIBRATION MODE SHAPES ARE RE-ORDERED IN AVAM TO CONFORM WITH THE REQUIREMENTS OF THE MODAL INTERPOLATION PROCEDURE IN AFAM.

C. MODAL PLOTS

THE CALCOMP PLOTTING OPTION IN THE VIBRATION PROGRAM OFFERS THE USER THE OPPORTUNITY OF GRAPHICALLY VIEWING THE NORMAL MODE SHAPES OF A STRUCTURE. WHEN THE OPTION IS SELECTED, THE USER SUPPLIES A PLOTTING GRID ON WHICH DISPLACEMENTS FROM THE MODAL MATRIX WILL BE PLOTTED. THE GRID IS COMPOSED OF A NUMBER OF 'BEAMS' WHICH CONNECT POINTS IN SPACE WHOSE COORDINATES CORRESPOND TO POSITIONS IN THE DYNAMICS GRID. (THE POINT NUMBERS ON ANY BEAM NEED NOT BE CONSECUTIVE INTEGERS. THE ONLY RESTRICTION IS THAT THE LARGEST NUMBER USED BE LESS THAN OR EQUAL TO 800.)

THE STRUCTURE TO BE VIEWED IS ALWAYS A LEFT-HAND SURFACE INITIALLY LYING IN THE X-Y PLANE WITH A LEFT-HAND COORDINATE SYSTEM LOCATED AT THE FORWARD-MOST INBOARD-MOST POINT (FIGURE

1). THE USER MUST SPECIFY THREE ANGLES OF ROTATION OF THE STRUCTURE TO OBTAIN THE DESIRED VIEW, WHICH WILL BE TAKEN ALONG THE NEGATIVE X AXIS. THE ORDER IN WHICH THE ROTATIONS ARE SPECIFIED WILL NOW BE DESCRIBED.

THE X-Y-Z COORDINATE SYSTEM SHOWN IN FIGURE 1 REMAINS FIXED IN SPACE AND THE SURFACE IS ROTATED ABOUT THE X AXIS THROUGH AN ANGLE, THETA1, (POSITIVE ACCORDING TO THE LEFT-HAND RULE). A SET OF AXES X'-Y'-Z' INITIALLY COINCIDENT WITH X-Y-Z BUT CONSIDERED TO BE FIXED TO THE SURFACE UNDERGO THE SAME ROTATION, THETA1. IF THE PLANE TO BE VIEWED WAS INITIALLY IN THE X-Y PLANE, THEN A VIEW ALONG THE X (OR X') AXIS FROM AFT TO FORE WILL PRODUCE THE PROJECTION SHOWN IN FIGURE 2A. THE PLANE PROJECTS AS AN EDGE ALONG THE Y' AXIS. FOLLOWING THIS ROTATION, THE X AND X' AXES ARE COINCIDENT BUT THE Y AND Y', Z AND Z' AXES ARE NOT. THE SURFACE IS THEN ROTATED THROUGH ANOTHER ANGLE, THETA2, ABOUT THE Y' AXIS WHICH REMAINS FIXED IN SPACE AND A SECOND COORDINATE SYSTEM X''-Y''-Z'', INITIALLY COINCIDENT WITH X'-Y'-Z' MOVES WITH THE SURFACE. THE Y' AND Y'' AXES ARE COINCIDENT FOLLOWING THE ROTATION, THETA2, BUT NOT X' AND X'' NOR Z' AND Z''. THE ORIENTATION OF THE X''-Y''-Z'' WITH RESPECT TO X'-Y'-Z' IS SHOWN IN FIGURE 2B WHICH IS A VIEW ALONG A VECTOR POINTING IN THE -Y' (OR -Y'') DIRECTION. THE PROCESS IS CONTINUED FOR ONE ADDITIONAL ROTATION, THETA3, ABOUT THE Z'' AXIS WHICH CAUSES THE SURFACE TO TAKE ITS FINAL POSITION IN SPACE FOR VIEWING. THIS ROTATION IS SHOWN IN FIGURE 2C WHICH IS A VIEW ALONG A VECTOR POINTING ALONG THE -Z'' (OR -Z''') AXIS. THUS, ANGLES THETA1, THETA2, AND THETA3 MAY EACH BE VARIED TO OBTAIN THE DESIRED PROJECTION ON THE CALCOMP PLANE. FOR EXAMPLE, IF THE USER WISHES TO OBTAIN AN 'ISOMETRIC' VIEW OF A WING WITH THE LEADING EDGE PITCHED DOWN, THE CHOICE FOR THE ANGLES ARE THETA1 = 0.0, THETA2 = 35.3 DEG., THETA3 = 225 DEG.

NOTE THAT ALTHOUGH THE COORDINATE DIRECTIONS ARE POSITIVE AS SHOWN IN FIGURE 1, (I.E., THEY FOLLOW THE LEFT-HAND RULE), THE MODAL TRANSLATIONS ARE PLOTTED ACCORDING TO THE DYNAMIC DISPLACEMENT SIGN CONVENTION, I.E., POSITIVE WHEN

1) POINTS DISPLACE ALONG THE FORWARD DIRECTION (X),
2) POINTS DISPLACE OUTBOARD ON THE LEFT WING (Y),
3) POINTS DISPLACE DOWNWARD (Z).

IN ADDITION TO THE VIEWING ANGLES AND THE GRID DESCRIPTION, THE USER MUST ALSO SPECIFY A RATIO BETWEEN THE MAXIMUM DISPLACEMENT AND THE LENGTH OF A PARTICULAR BEAM IN THE GRID. THIS RATIO IS USED BY THE PROGRAM TO SCALE THE MODAL DISPLACEMENTS TO PRODUCE APPROPRIATE DEFLECTION LENGTHS ON THE GRID. REASONABLE PLOTS ARE OBTAINED BY CHOOSING THIS NUMBER TO BE .15 OR .20 WHEN THE REFERENCE BEAM IS SET TO BE ONE OF THE LONGER ONES IN THE GRID. ADDITIONALLY THE PROGRAM WILL AUTOMATICALLY ADJUST THE SCALING OF OVERALL CALCOMP PLOT, SO THAT EITHER THE ENTIRE 'PICTURE SPACE' IN THE CALCOMP VERTICAL DIRECTION (CURRENTLY 7.2 INCHES) OR THE SPACE IN THE HORIZONTAL DIRECTION (CURRENTLY 12 INCHES) IS FILLED BY THE SCALED PLOT. THIS PLOT IS THEN CENTERED BETWEEN THE UPPER AND LOWER EDGES OF

THE CALCOMP SHEET.

THE DISPLACEMENT FOR EACH GRID POINT IS OBTAINED BY IDENTIFYING THAT POINT WITH A DEGREE OF FREEDOM IN THE VIBRATION MODEL. THIS PERMITS THE PROGRAM TO RETRIEVE THE APPROPRIATE DISPLACEMENT FROM THE MODAL MATRIX, SCALE IT AND THEN PLOT IT AT THE POINT IN THE APPROPRIATE SPATIAL DIRECTION. THE DISPLACEMENTS AT EACH GRID POINT ON A BEAM ARE JOINED BY A CURVE GENERATED BY THE FERGUSON CURVE-FITTING SUBROUTINE. THIS ROUTINE PERFORMS A SPLINE INTERPOLATION WHICH YIELDS DISPLACEMENTS AT INTERMEDIATE POINTS BETWEEN CONSECUTIVE GRID POINTS. THE NUMBER OF INTERMEDIATE INTERVALS MAY BE ANY INTEGRAL FACTOR OF 24 (1, 2, 3, 4, 6, 8, 12, 24). CURRENTLY, THE PROGRAM USES A FIXED VALUE OF 4 SUCH INTERVALS IN DEFINING THE UNDEFORMED GRID 'BEAMS' AND 24 INTERVALS IN DRAWING THE DISPLACED MODE CURVE. THE USER MAY, OF COURSE, CHANGE THESE NUMBERS BY REDEFINING CONSTANTS CONTAINED WITHIN THE PROGRAM.

AN ADDITIONAL COMMENT IS NECESSARY IN ORDER TO ENABLE THE USER TO PLOT THE MODE SHAPES OF A CANTILEVER STRUCTURE. BECAUSE SUCH A STRUCTURE IS FIXED IN SPACE, NO DYNAMIC DEGREES OF FREEDOM EXIST AT THE EDGE OF A FIXITY. YET WHEN THE MODE SHAPES ARE PLOTTED THE USER WOULD CERTAINLY WANT TO SEE A PLOT WITH ZERO DISPLACEMENTS AT THE FIXED EDGE. TO ACHIEVE THIS, THE USER SPECIFIES PLOTTING GRID POINTS AT THE FIXED EDGE JUST AS HE WOULD FOR OTHER GRID POINTS IN THE CANTILEVER STRUCTURE. HOWEVER WHERE THE INFORMATION REQUIRING THE DEGREE OF FREEDOM FOR THE POINTS AT THE FIXED EDGE TO BE SPECIFIED, HE WILL LEAVE THIS FIELD BLANK ON THE DATA CARD. A DEFAULT VALUE OF ZERO WILL THEN BE PLOTTED AT THE POINT.

SOME OF THE LIMITATIONS IN THE USE OF THE PROGRAM FOLLOW.

1) MAXIMUM NUMBER OF BEAMS IN GRID = 40.
2) MAXIMUM NUMBER OF POINTS ON A BEAM = 20,
3) MAXIMUM GRID POINT NUMBER = 800.

IN LIGHT OF THIS INFORMATION, THE USER WILL NECESSARILY BREAK UP ANY BEAM WHOSE NUMBER OF POINTS IS GREATER THAN 20. THIS WILL THEN PRODUCE A SLOPE DISCONTINUITY IN THE MODE SHAPE AT THE JUNCTURE POINT.

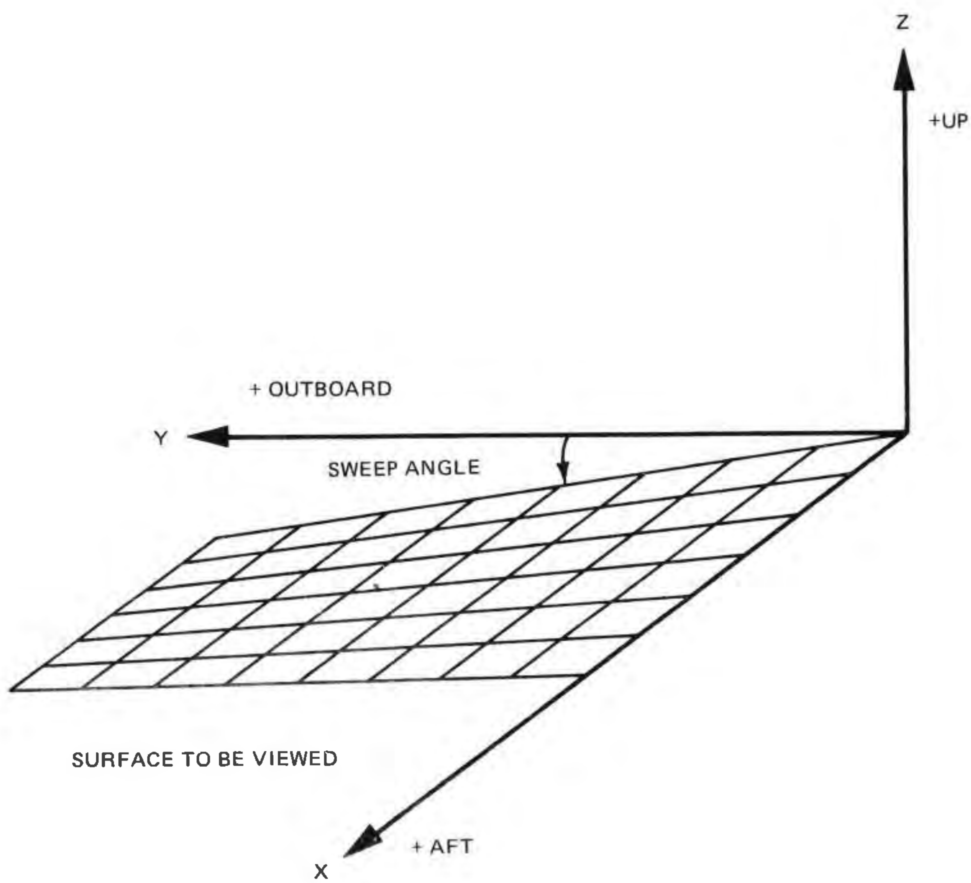
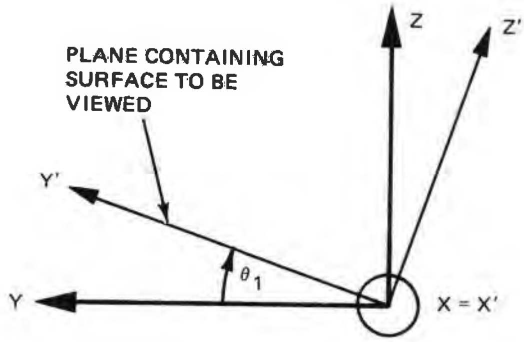
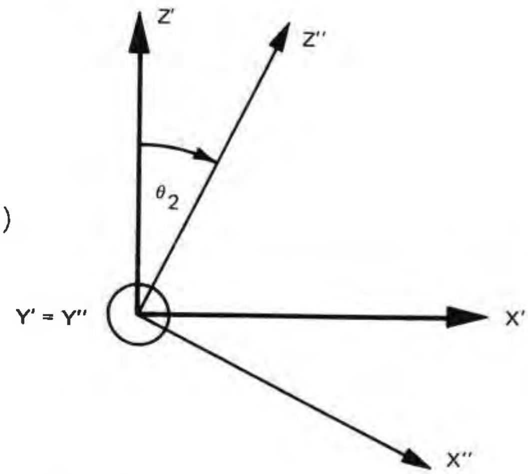


Figure 1 Relationship of Coordinate System and Surface for Modal Plots

a. Rotation About X-Axis (θ_1)



b. Rotation About Y'-Axis (θ_2)



c. Rotation About Z''-Axis (θ_3)

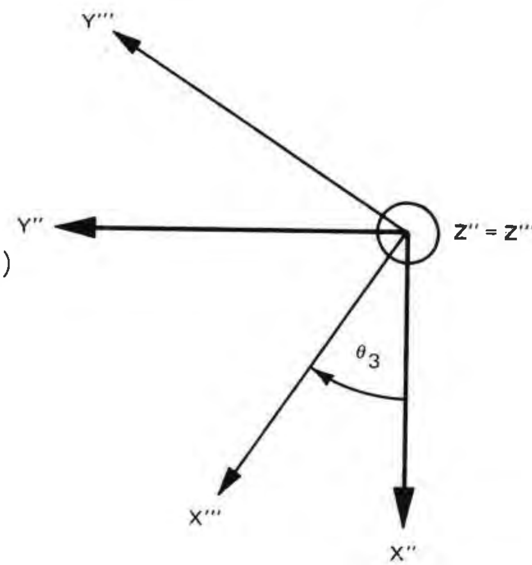


Figure 2 Sequence of Rotations for Desired View of Mode Shapes

AFAM - AUTOMATED FLUTTER ANALYSIS MODULE

I. PROGRAM APPLICATION

A. GENERAL DESCRIPTION AND LIMITATIONS

1. MODAL INPUT

FLUTTER ANALYSES MAY BE PERFORMED USING A MAXIMUM OF 20 MODES OF VIBRATION.

2. SUBSONIC DOUBLET-LATTICE AERODYNAMIC ROUTINE

THIS ROUTINE IS A MODIFIED VERSION OF THE PROCEDURE DEVELOPED BY GIESING, KALMAN, AND RODDEN, REPORTED IN AFFDL-TR-71-5. THE FASTOP VERSION OF THE ROUTINE ALLOWS AERODYNAMIC MODELING WITH A MAXIMUM OF 400 ELEMENTS. INPUT DATA REQUIREMENTS ARE ILLUSTRATED IN FIGURES 2 - 5. (REFERENCE TO THESE FIGURES WILL BE FOUND IN THE AFAM INPUT DATA DESCRIPTION). APPLICABLE MACH RANGE 0 - 0.9.

3. ASSUMED - PRESSURE - FUNCTION AERODYNAMIC ROUTINE

THIS SUBSONIC AERODYNAMIC PROCEDURE CAN ONLY BE USED TO COMPUTE THE AERODYNAMIC FORCES FOR PLANAR (NON-INTERFERING) AERODYNAMIC SURFACES WITHOUT CONTROL SURFACES OR FLAPS. THE LATTER RESTRICTION IS DUE TO THE ABSENCE OF PROGRAMMED PRESSURE POLYNOMIALS WHICH WOULD BE REQUIRED TO CORRECTLY SIMULATE THE PRESSURE SINGULARITY THAT OCCURS AT A CONTROL SURFACE LEADING EDGE. INPUT DATA REQUIREMENTS ARE ILLUSTRATED IN FIGURES 9 AND 10. APPLICABLE MACH RANGE 0 - 0.9.

4. SUPERSONIC MACH-BOX AERODYNAMIC ROUTINE

THIS ROUTINE IS APPLICABLE TO PLANAR NON-INTERFERING SURFACES IN THE MACH RANGE 1.2 - 3.0. UNSTEADY AERODYNAMIC FORCES MAY BE COMPUTED FOR ANY COMBINATION OF SUBSONIC OR SUPERSONIC LEADING AND TRAILING EDGE FLOW CONFIGURATIONS. BOX GEOMETRY IS COMPUTED AUTOMATICALLY WITHIN THE PROGRAM BASED ON THE DESIRED NUMBER OF WING BOXES SPECIFIED BY THE USER (MAXIMUM OF 350 EXCLUDING DIAPHRAGM). SPECIFICATION OF PLANFORM GEOMETRY IS ILLUSTRATED IN FIGURE 8.

5. MODAL INTERPOLATION

THE AUTOMATED MODAL INTERPOLATION ROUTINE COMPUTES THE MODAL

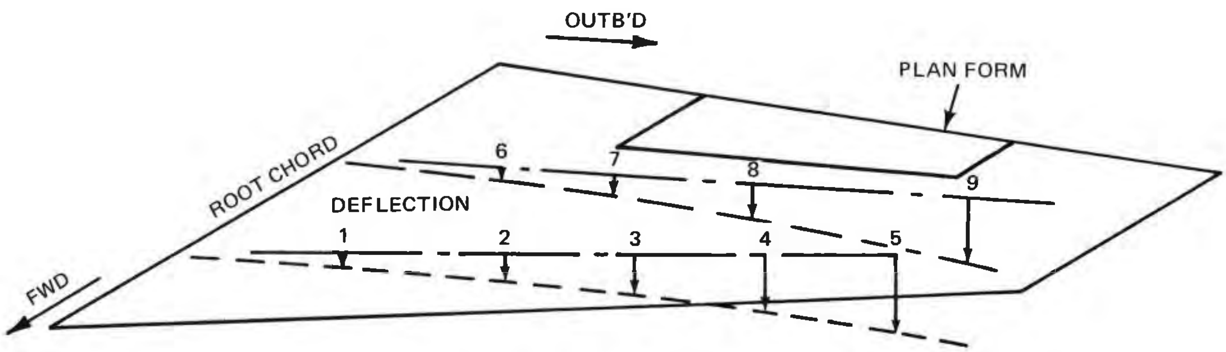
DEFLECTIONS AT THE REQUIRED DOWNWASH AND LIFT POINTS FOR ANY OF THE THREE AVAILABLE AERODYNAMIC ROUTINES. THE ROUTINE ALSO PERMITS THE USER TO SPECIFY THE DISCONTINUOUS DOWNWASH ASSOCIATED WITH CONTROL SURFACES ATTACHED TO THE MAIN AERODYNAMIC SURFACE (MAXIMUM OF FIVE). THIS LATTER CAPABILITY CAN BE USED IN CONJUCTION WITH THE DOUBLET-LATTICE OR MACH-BOX ROUTINES. THE INPUT DATA REQUIREMENTS ASSOCIATED WITH MODAL INTERPOLATION AND CONTROL SURFACE REPRESENTATION ARE ILLUSTRATED IN FIGURES 1, 6, AND 7. (REFERENCE TO THESE FIGURES WILL BE FOUND IN THE AFAM INPUT DATA DESCRIPTION).

6. SOLUTION PROCEDURES

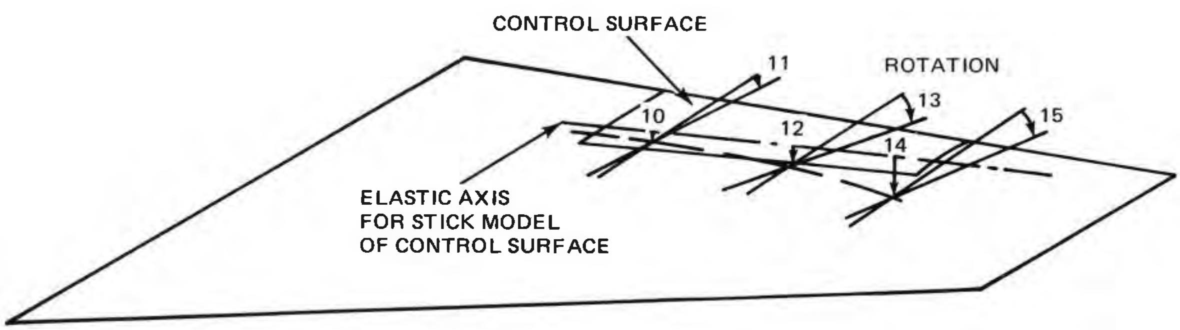
FLUTTER SOLUTIONS MAY BE OBTAINED BY THE CONVENTIONAL K - METHOD OR THE P - K METHOD. THE LATTER PROCEDURE MUST BE USED FOR FLUTTER REDESIGN.

7. AERODYNAMIC INFLUENCE MATRICES

IN ALL THREE AERODYNAMIC ROUTINES PROVISION IS MADE TO SAVE THE AERODYNAMIC INFLUENCE COEFFICIENT MATRICES GENERATED IN THE INITIAL FLUTTER ANALYSIS. THESE SAVED 'AIC' MATRICES MAY THEN BE USED IN A SUBSEQUENT FLUTTER ANALYSIS, RESULTING IN A SIGNIFICANT SAVING IN COMPUTATIONAL TIME.

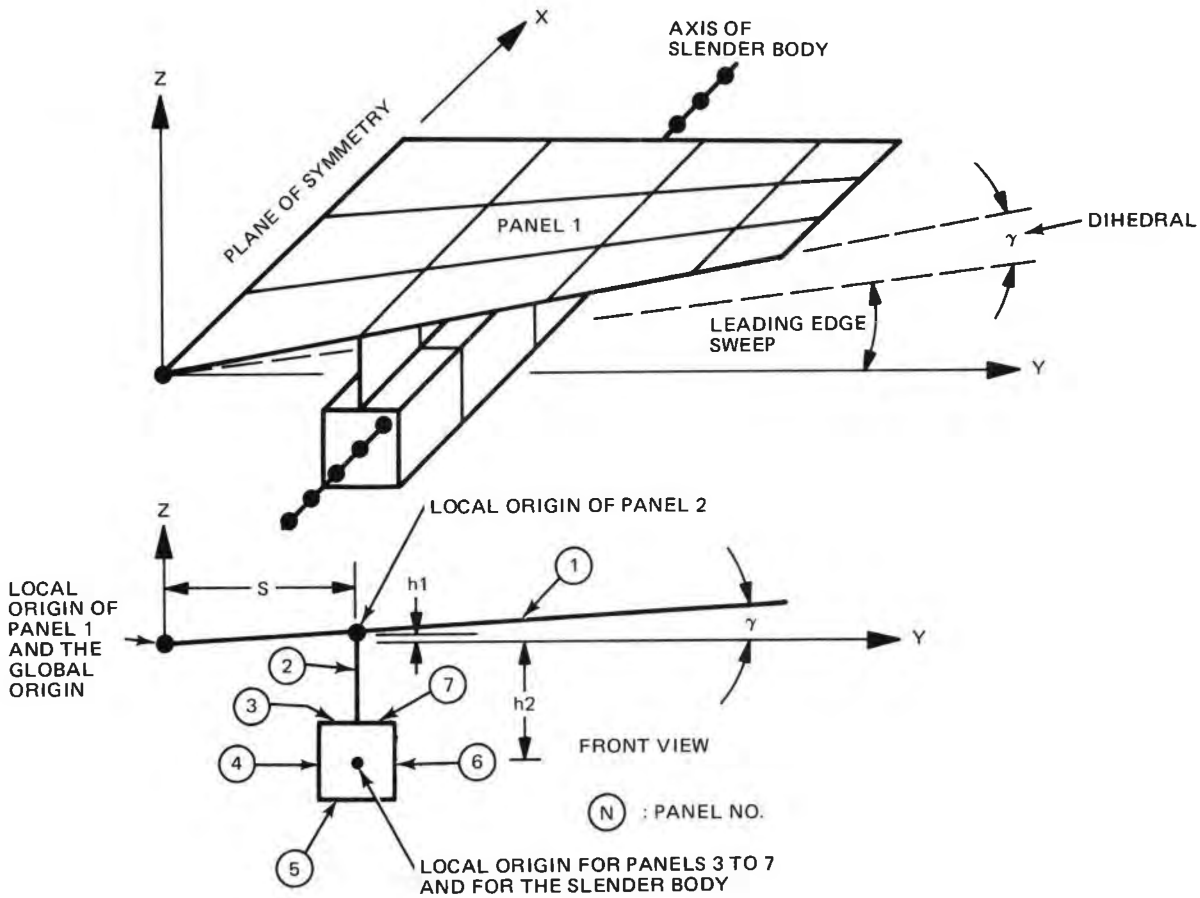


a. Primary Surface Mode Shape



b. Control Surface Mode Shape

Figure 1 Sequence of Input Modal Data for Primary Surface and Control Surface with 15 Coordinates

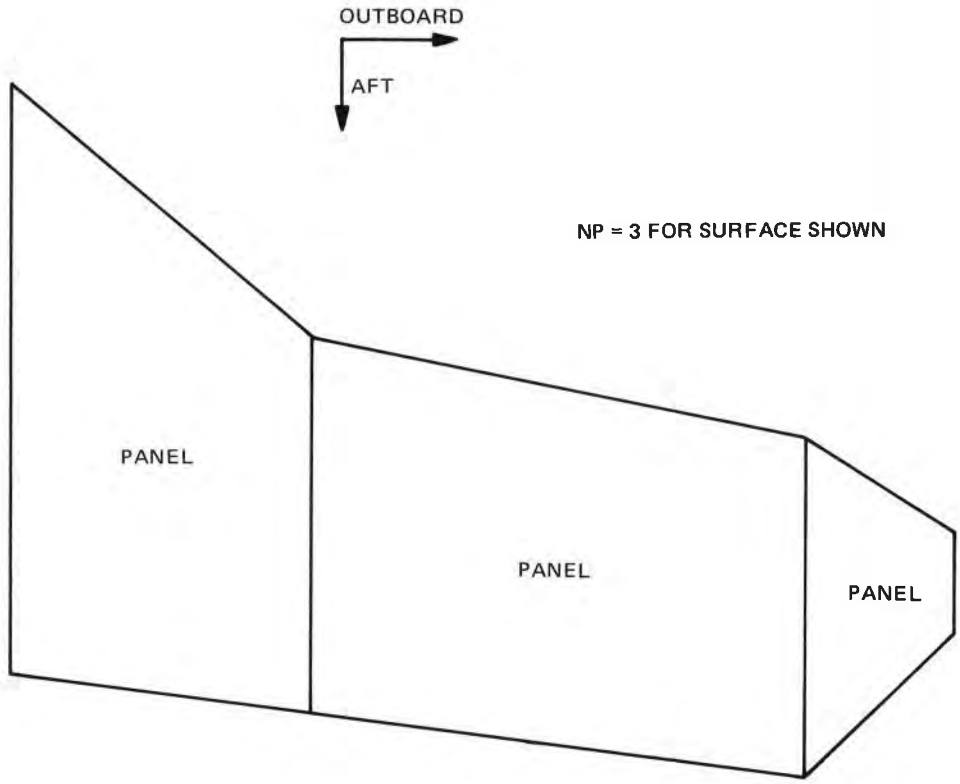


REFERENCE COORDINATES

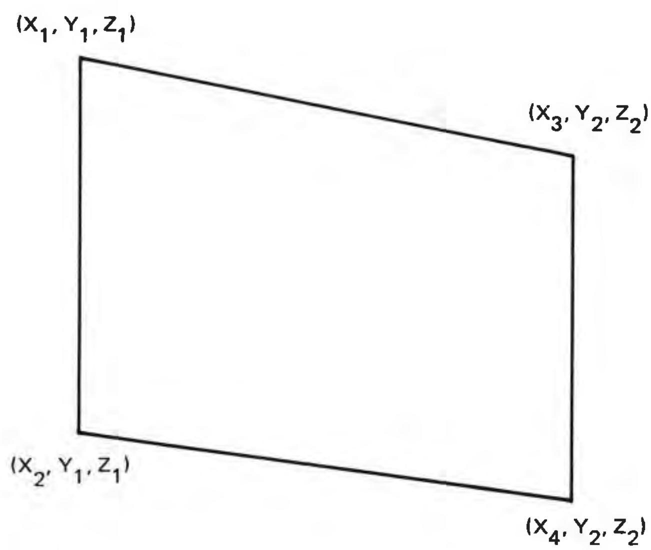
XO(1)	=	0.	YO(1)	=	0.	ZO(1)	=	0.	GGMAS(1)	=	γ
XO(2)	=	0.	YO(2)	=	S	ZO(2)	=	h1	GGMAS(2)	=	$-90°$
XO(3)	=	0.	YO(3)	=	S	ZO(3)	=	-h2	GGMAS(3)	=	0.
XO(4)	=	0.	YO(4)	=	S	ZO(4)	=	-h2	GGMAS(4)	=	0.
XO(5)	=	0.	YO(5)	=	S	ZO(5)	=	-h2	GGMAS(5)	=	0.
XO(6)	=	0.	YO(6)	=	S	ZO(6)	=	-h2	GGMAS(6)	=	0.
XO(7)	=	0.	YO(7)	=	S	ZO(7)	=	-h2	GGMAS(7)	=	0.
XBO(1)	=	0.	YBO(1)	=	S	ZBO(1)	=	-h2			

NOTE: INTERFERENCE PANELS ASSOCIATED WITH A BODY MUST HAVE THE SAME LOCAL ORIGIN AS THE AXIAL ELEMENTS OF THAT BODY. ALSO, THE BODY CAN ONLY BE TRANSLATED INTO THE GLOBAL SYSTEM; I.E. GGMAS(3) THROUGH GGMAS(7) = 0.

Figure 2 Doublet-Lattice Procedure, Using Reference Coordintes in Locating Panels and Slender Body Elements

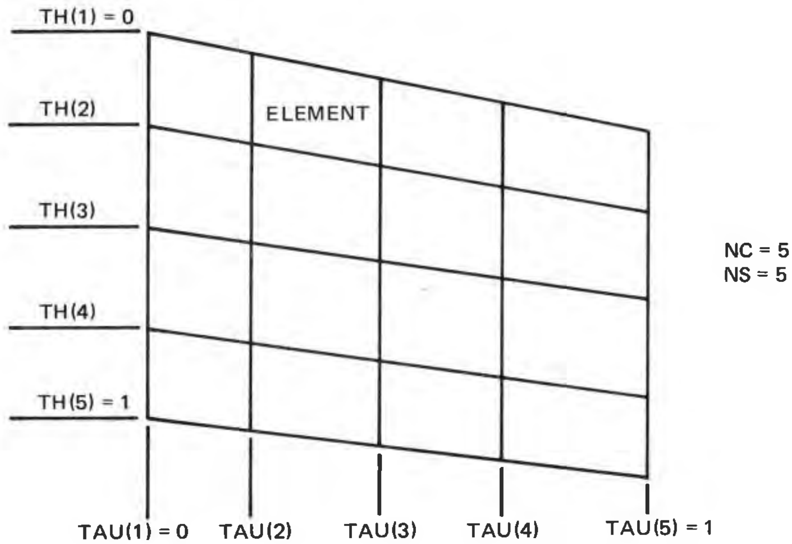


a. Division of Surface into Panels

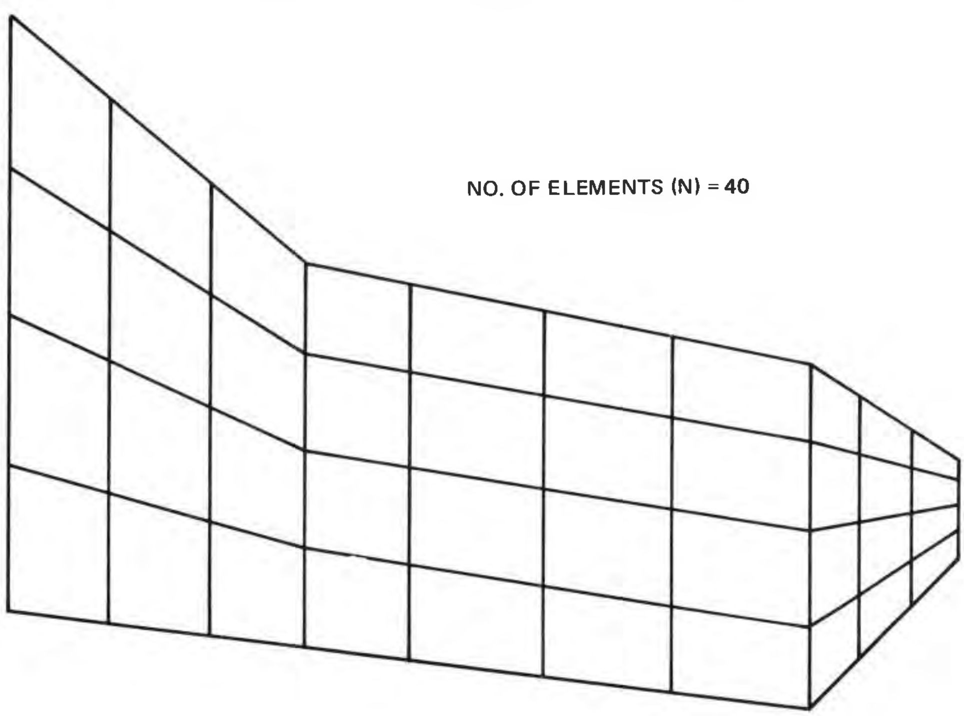


b. Panel Edge Coordinates

Figure 3 Doublet-Lattice Procedure, Surface Geometry Definition of Panels



a. Division of Panel into Elements



b. Division of Surface into Elements

Figure 4 Doublet-Lattice Procedure, Surface Geometry Definition of Elements

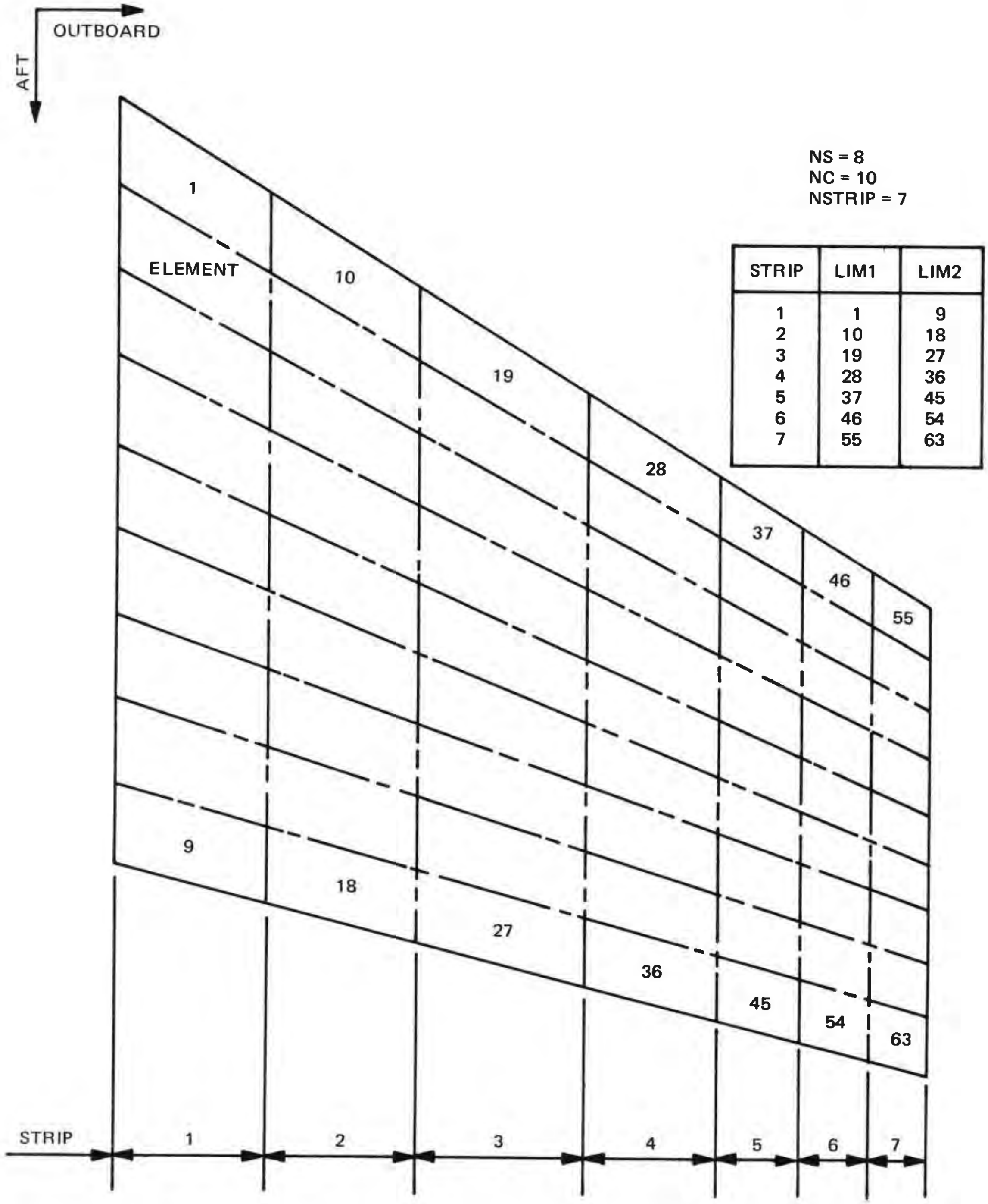
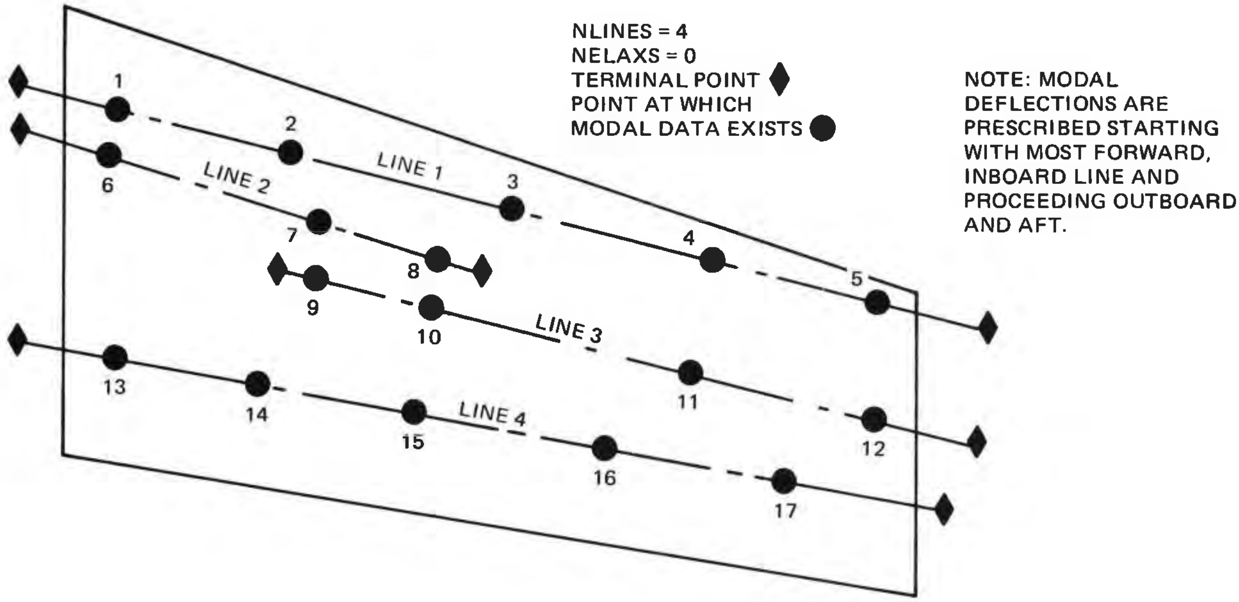
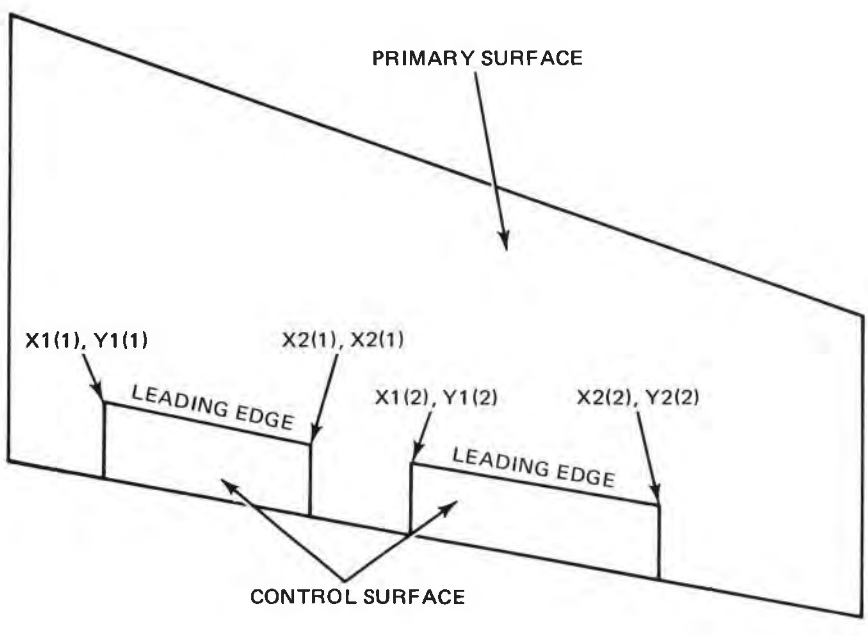


Figure 5 Doublet-Lattice Procedure, Example of Chordwise Limits in Strip for Single Surface

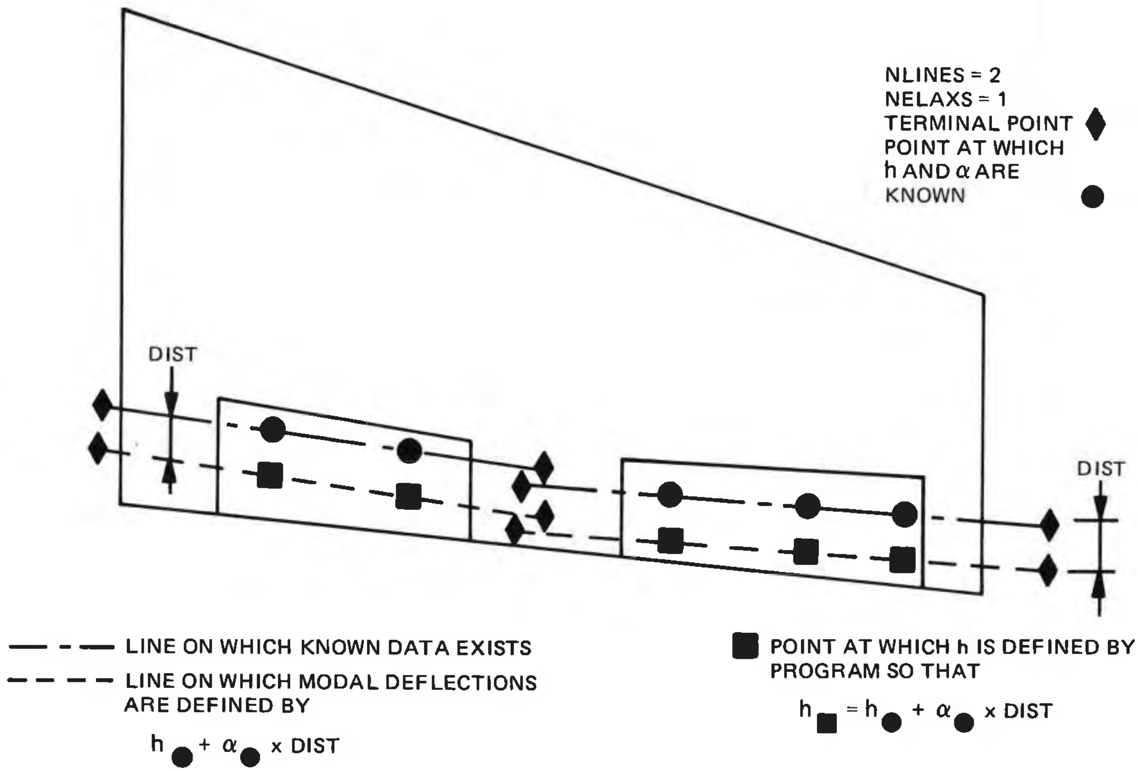


a. Line Definition on Primary Surface for Specifying Modal Data

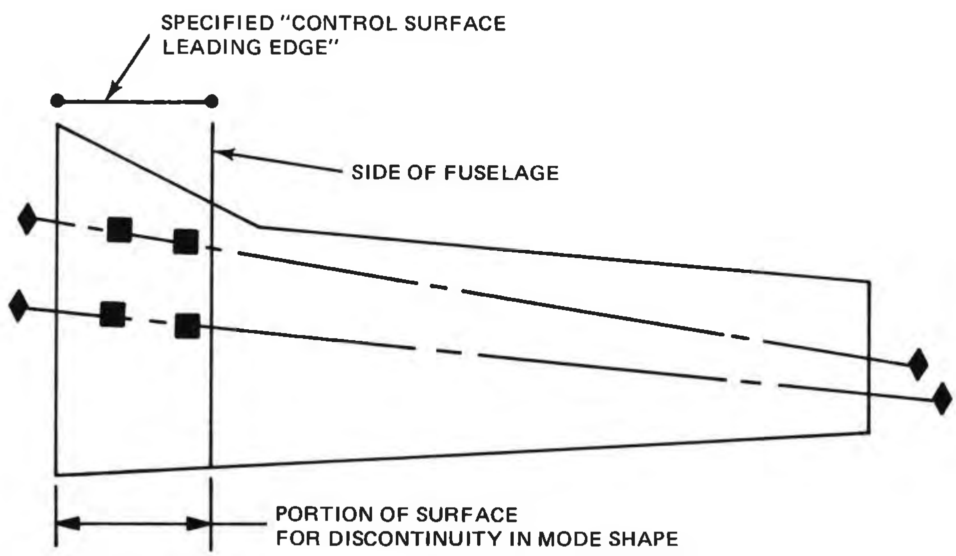


b. Definition of Control Surface Geometry

Figure 6 Definition of Modal Displacements for Primary Surface and Control Surface Geometry



a. Modal Data Input-Line Definition on Control Surfaces For Stick Model Representation



b. Use of Control Surface Option to Define Spanwise Modal Discontinuity

Figure 7 Definition of Control Surface Modal Deflections

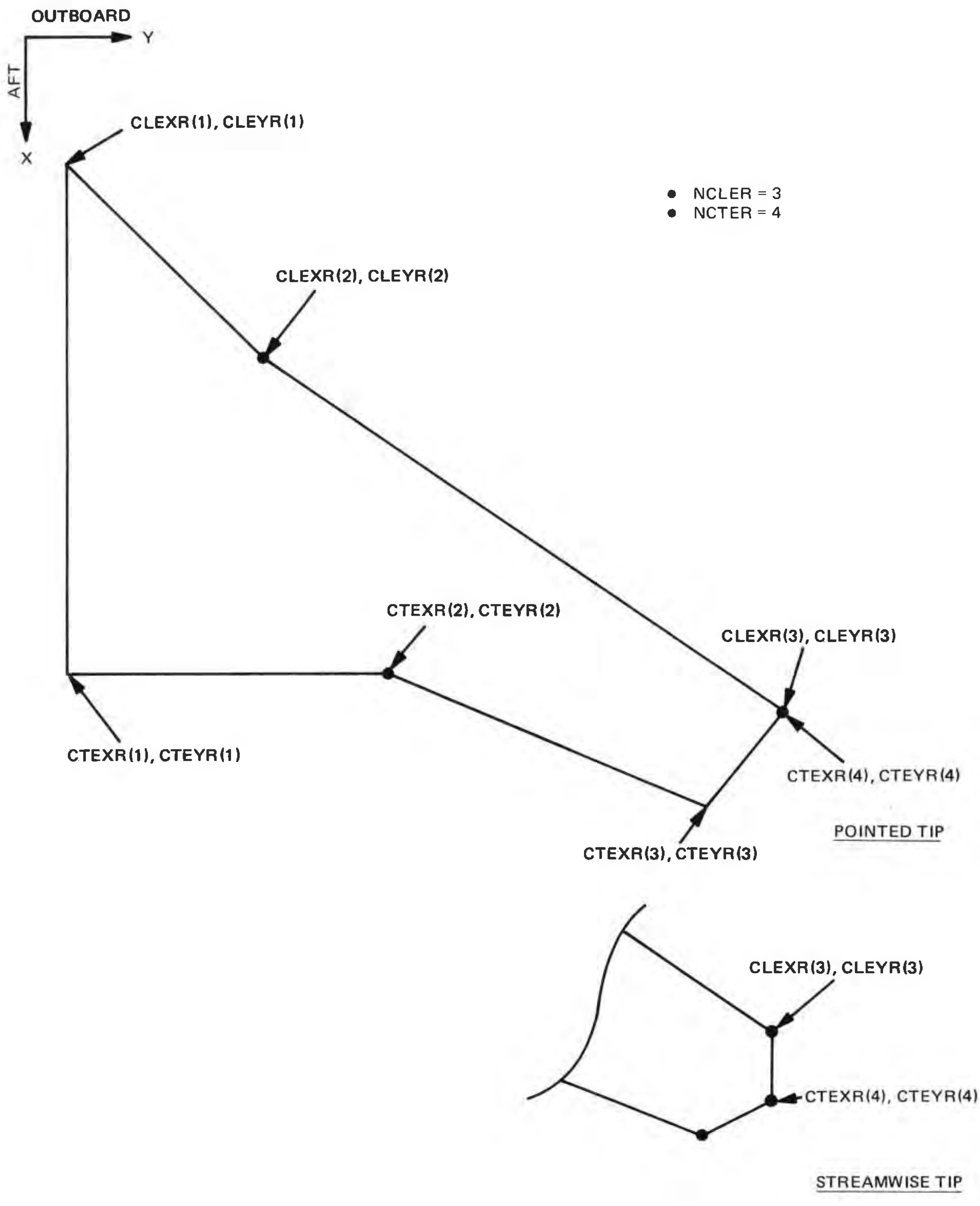


Figure 8 Mach-Box Procedure for Surface Geometry Definition

	NC											
MC	1	2	3	4	5	6	7	8	9	10	11	12
2	2	7	12	17	22	27	32	37	43	47	52	57
3	3	10	17	24	31	38	45	52	59			
4	4	13	22	31	40	49	58					
5	5	16	27	38	49	60						
6	6	19	32	45	58							
7	7	22	37	52								
8	8	25	42	59								
9	9	28	47									
10	10	31	52									

TABLE BASED UPON MAXIMUM NUMBER (60)

Figure 9 Assumed-Pressure-Function Procedure, Number of Integration Points Per Chord as a Function of Input Parameters MC and NC

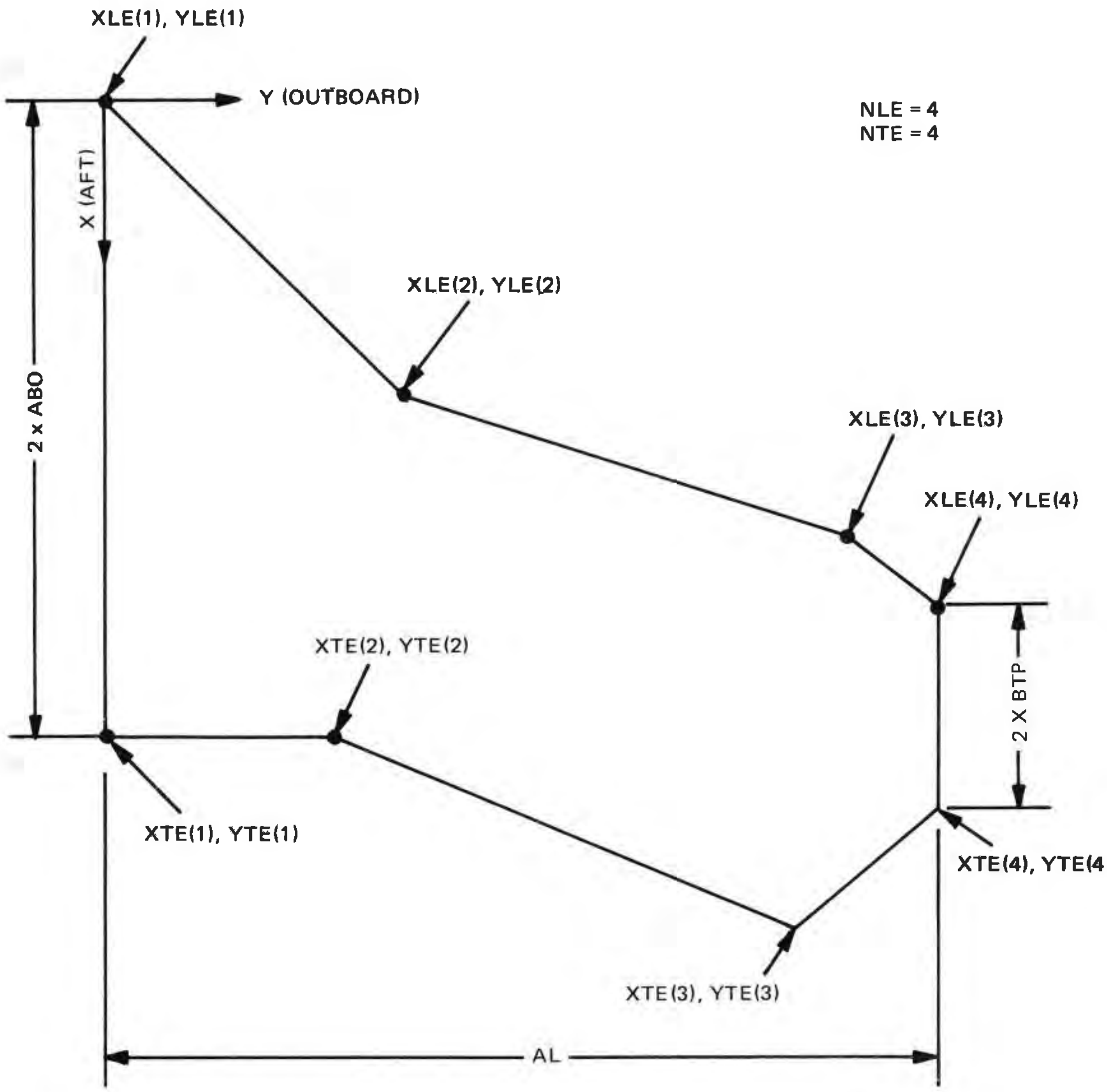


Figure 10 Assumed-Pressure-Function Procedure, Surface Geometry Definition

AFOM - AUTOMATED FLUTTER OPTIMIZATION MODULE

I. EXPLANATION OF USER-SPECIFIED FLUTTER REDESIGN PARAMETERS

FIGURE 1 ILLUSTRATES A SITUATION WHERE THE USER SPECIFIES NBAR = 4 ATTEMPTING TO REACH THE MIDPOINT OF THE 'FLUTTER BAND' IN FOUR REDESIGN CYCLES. IT IS NOTED THAT DESIGN POINT 4 IS NOT AT THE TARGET FLUTTER SPEED SINCE THE PREDICTED AND ACTUAL FLUTTER SPEED INCREMENTS FOR THE LAST REDESIGN WERE NOT IDENTICAL. ALL REDESIGNS AFTER POINT 3 USED (V SUB F DESIRED)* (1 + EPS1/2) AS THE TARGET FLUTTER SPEED.

SINCE DESIGNS 7 AND 8 ARE IN THE FLUTTER BAND, THE DESIGN WOULD BE CONVERGED IF DELW WERE LESS THAN DWMAX. ALSO NO MORE THAN NFIX REDESIGNS WOULD ACTUALLY BE PERFORMED. THUS, IF NFIX = 3, THE PROGRAM WOULD HAVE STOPPED AT DESIGN POINT 3.

II. PROGRAM LIMITATIONS

THE MAXIMUM NUMBER OF ELEMENTS WHICH CAN BE RESIZED FOR FLUTTER IS.

A. 2000 STRUCTURAL ELEMENTS

B. 20 MASS BALANCE ELEMENTS

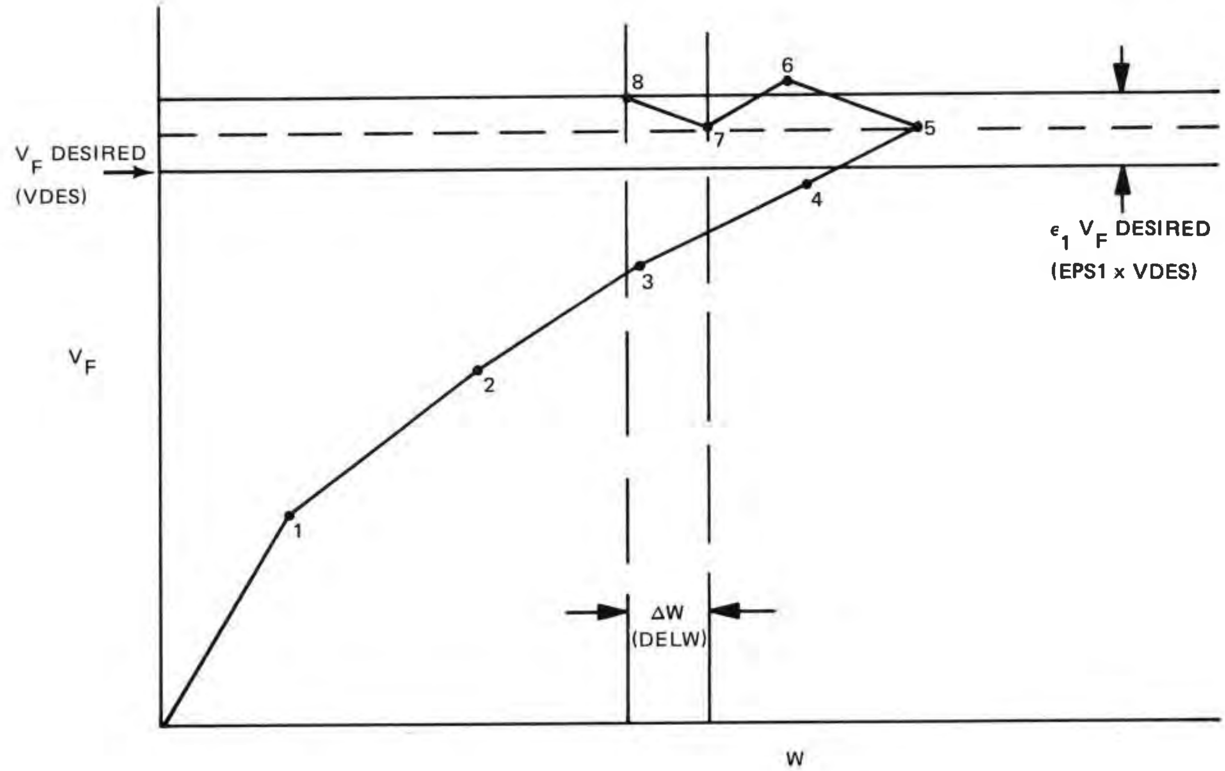


Figure 1 Illustrative Description of Redesign Parameters

INPUT

MAIN PROGRAM (FOP)

I. CONTROL WORD OPTION DESCRIPTION

THE AVAILABLE OPTIONS TO EXECUTE THE FLUTTER OPTIMIZATION PACKAGE IN WHOLE OR IN PART OR TO INTRODUCE SIMPLIFICATIONS, ARE EXERCISED THROUGH CERTAIN CONTROLS ENTERED AS CARD DATA. THE GENERAL VARIABLE KLUE(I) REPRESENTS THE DATA CONTROL WORD OPTIONS USED TO STORE INFORMATION READ FROM CARDS. A ZERO VALUE IS USED FOR ELIMINATING THE OPTIONS WHEREAS A VALUE CORRESPONDING TO THE INDEX ASSOCIATED WITH THE SEQUENTIAL NUMBER OF THE VARIABLE, KLUE(I), IS USED FOR EXERCISING THE OPTION. IN ORDER TO MINIMIZE THE AMOUNT OF DATA THE USER MUST PROVIDE, THE CONTROL WORD OPTION KLUE(I) IS INITIALIZED TO ZERO WITHIN THE PROGRAM. THE USER IS REQUIRED TO PROVIDE DATA ONLY FOR THOSE OPTIONS HE WANTS EXERCISED PUNCHED WITH FOUR COLUMNS EACH AND RIGHT JUSTIFIED WITH THE CONDITION THAT THE LAST CONTROL WORD OPTION MUST BE NEGATIVE. FOR EXAMPLE (SEE 'CARD INPUT' SECTION) IF ONLY VIBRATION AND FLUTTER ANALYSIS ARE TO BE PERFORMED THE CARD MAY BE PUNCHED AS FOLLOWS.

```
------------------------------------
00000000 ... 44
12345678 ... 34
------------------------------------
   3|  -4|    KLUE(I), I=3 AND I=4.
------------------------------------
```

WHERE COLUMNS ONE THROUGH FORTY ARE USED FOR DATA AND COLUMNS FORTY ONE THROUGH SEVENTY TWO ARE USED FOR IDENTIFICATION.

II. SUMMARY OF CONTROL WORD OPTIONS AND ITEMS AFFECTED BY THEM

THE VARIABLE KLUE(I) REPRESENTS THE CARD INPUT DATA CONTROL WORD OPTIONS ASSOCIATED WITH FOP. IT IS ENTERED AS DATA IN ITEM 6.

KLUE(3) OPTION FOR PERFORMING VIBRATION ANALYSIS. AFFECTS ALL DATA IN AUTOMATED VIBRATION ANALYSIS MODULE (AVAM).

KLUE(4) OPTION FOR PERFORMING FLUTTER ANALYSIS. AFFECTS ALL DATA IN AUTOMATED FLUTTER ANALYSIS MODULE (AFAM).

KLUE(7) OPTION FOR ENTERING FLUTTER OPTIMIZATION MODULE. AFFECTS ALL DATA IN AUTOMATED FLUTTER OPTIMIZATION MODULE (AFOM). ALSO, AFFECTS ITEMS 10 AND 14 IN AVAM.

KLUE(8) OPTION FOR INCLUDING RESULTS IN A REPORT. DOES NOT AFFECT ANY DATA.

KLUE(9) OPTION FOR LISTING LABELS OF FILES GENERATED BY DSIO AND FSIO (DISK AND FORTRAN SEQUENTIAL INPUT/OUTPUT). DOES NOT AFFECT ANY INPUT DATA.

KLUE(10) OPTION FOR LISTING MESSAGES WHEN ENTERING AND LEAVING SUBROUTINES. DOES NOT AFFECT ANY INPUT DATA.

KLUE(11) OPTION FOR LISTING MAIN HEADING ENTERED FROM CARD DATA. DOES NOT AFFECT ANY INPUT DATA.

KLUE(12) OPTION FOR LISTING SUBHEADING ENTERED FROM CARD DATA. DOES NOT AFFECT ANY INPUT DATA.

KLUE(13) OPTION FOR LISTING INTERMEDIATE LABEL INFORMATION. DOES NOT AFFECT ANY INPUT DATA.

KLUE(14) OPTION FOR LISTING COMPUTER TIMES AT INTERVALS DURING PROGRAM EXECUTION. DOES NOT AFFECT ANY INPUT DATA.

KLUE(26) OPTION FOR INDICATING THAT THIS IS THE FIRST PASS FROM SOP TO FOP PROGRAMS. AFFECTS KLUEV(5), ITEM 3, IN AVAM. ALSO, AFFECTS ITEMS 5 TO 17 AND 19 IN AVAM.

KLUE(27) OPTION FOR INDICATING THAT THE DYNAMICS AND STRUCTURAL DEGREES OF FREEDOM ARE IDENTICAL. DOES NOT AFFECT ANY INPUT DATA.

KLUE(28) OPTION FOR INDICATING THAT THE DYNAMIC MASS MATRIX IS PROVIDED BY THE USER OR COMPUTED. AFFECTS KLUEV(5), ITEM 3, IN AVAM. ALSO, AFFECTS ITEMS 10 TO 15 IN AVAM.

KLUE(29) OPTION FOR INDICATING THAT THE FIXED MASS ITEMS ARE PROVIDED AND TO BE CONSIDERED. AFFECTS ITEMS 13 TO 15 IN AVAM.

KLUE(30) OPTION FOR INDICATING THAT THE FIXED MASS ITEMS CONTRIBUTE TO THE OFF-DIAGONAL TERMS. DOES NOT AFFECT ANY DATA.

KLUE(31) OPTION FOR CONSIDERING MASS BALANCE VARIABLES. AFFECTS ITEMS 8 AND 19 IN AVAM.

KLUE(32) OPTION FOR SUPERSEDING EXISTING MASS BALANCE DATA WITH NEW DATA. AFFECTS ITEM 19 IN AVAM.

KLUE(33) OPTION FOR INDICATING THAT ASAM/ASOM DID ANALYZE OR REDESIGN THE STRUCTURE OR SIMPLY COMPUTED THE DYNAMIC FLEXIBILITY OR THE STRUCTURAL STIFFNESS MATRICES. DOES NOT AFFECT ANY DATA

KLUE(34) OPTION FOR PERFORMING FLUTTER REDESIGN ALONG WITH

COMPUTING THE FLUTTER VELOCITY DERIVATIVES. AFFECTS ITEM 10 IN AVAM AND ITEMS 6 TO 8 IN AFOM.

KLUE(35) OPTION FOR INCLUDING NON-OPTIMUM WEIGHT FACTORS. AFFECTS ITEM 6 IN AVAM.

KLUE(36) OPTION FOR EXCLUDING SPECIFIED STRUCTURAL MEMBERS FROM THE FLUTTER REDESIGN PROCESS. AFFECTS ITEM 6 IN AVAM.

KLUE(37) OPTION FOR DEFINING EITHER A CANTILEVER OR FREE-FREE SURFACE VIBRATION ANALYSIS. AFFECTS ITEM 17 IN AVAM.

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*****************************************************************
*                                                               *
*     III.  PREPARATION OF CARD DATA                            *
*     ------------------------------                            *
*                                                               *
*       CARD INPUT DATA MUST ALWAYS BE ENTERED FOR THE MAIN     *
*     PROGRAM. REMAINING DATA WILL DEPEND UPON THE OPTIONS THE  *
*     USER IS EXERCISING.                                       *
*                                                               *
*****************************************************************
*                                                               *
*  1. ... FOP                IDENTIFIES THE BEGINNING OF THE    *
*     .                      CARD INPUT DATA TO THE FLUTTER     *
*     .                      OPTIMIZATION PACKAGE (FOP).        *
*     .                      USED WITHIN THE PROGRAM TO GENERATE *
*     .                      THE PERTINENT TITLE AND REFERENCE  *
*     .                      PAGE NUMBER APPEARING IN THE TABLE *
*     .                      OF CONTENTS AT THE END OF EACH RUN. *
*     .                       MUST BE ENTERED AS SHOWN.         *
*     .                                                         *
*     .    LINESI            LINES PER INCH USED BY THE CURRENT *
*     .                      PRINTERS FOR LISTING RESULTS.  A   *
*     .                      VALUE OF SIX SHOULD BE ENTERED WHEN *
*     .                      THE PRINTER UTILIZES EITHER AN     *
*     .                      ELEVEN BY FIFTEEN INCH PAPER WITH  *
*     .                      SIX LINES PER INCH DENSITY OR AN   *
*     .                      EIGHT AND ONE HALF BY FIFTEEN INCH *
*     .                      PAPER WITH EIGHT LINES PER INCH    *
*     .                      DENSITY.  A VALUE OF EIGHT SHOULD  *
*     .                      BE ENTERED WHEN THE PRINTER   .    *
*     .                      UTILIZES AN ELEVEN BY FIFTEEN INCH *
*     .                      PAPER WITH EIGHT LINES PER INCH    *
*     .                      DENSITY.  A DEFAULT VALUE OF SIX IS *
*     .                      PROVIDED IN SUBROUTINE LDB WHENEVER *
*     .                      ANY OTHER VALUE IS PRESENT ON THE  *
*     ...                    CARD.                              *
*                                                               *
*     ------------------------                                  *
*     |000000000111111111122222|                                *
*     |123456789012345678901234|                                *
*     ------------------------                                  *
*     |FOP|   |   PACAGE, LINESI|                               *
*     ------------------------                                  *
*                                                               *
*     FORMAT = (1A4, 1I4).  NUMBER OF CARDS IS 1.               *
*                                                               *
*     THE VARIABLE FOP IS ENTERED BY SUBROUTINE FOP AND         *
*     SUBROUTINE LDB WHERE IT IS PASSED TO SUBROUTINE DTABLE    *
*     TO GENERATE THE PROPER HEADING FOR THE TABLE OF           *
*     CONTENTS.  THE VARIABLE LINESI IS ENTERED BY SUBROUTINE   *
*     FOP AND SUBROUTINE LDB WHERE IT IS COMPARED AGAINST THE   *
*     STANDARD VALUES OF SIX AND EIGHT AND USES EITHER ONE OF   *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*     THEM OR THE DEFAULT VALUE OF SIX IF THE WRONG VALUE HAS    *
*     BEEN PUNCHED ON THE CARD.                                  *
******************************************************************
*                                                                *
*                                                                *
*     REPEAT THE FOLLOWING ITEM FOR I =1,2, AND                  *
*     ENTER (EIGHTEEN WORDS PER CARD) FOR L=1,....,18.           *
*                                                                *
*  2. ... TMH(L,I)        MAIN TITLE CONSISTING OF TWO CARDS.    *
*     .                   WILL BE LISTED AT THE TOP OF EACH      *
*     ...                 PAGE OF THE LISTED RESULTS.            *
*                                                                *
*     FORMAT = (18A4).  NUMBER OF CARDS IS 2.                    *
*                                                                *
*     DATA ARE ENTERED BY SUBROUTINE FOP.                        *
*                                                                *
******************************************************************
*                                                                *
*                                                                *
*     IN ADDITION TO THE ABOVE TITLE ADDITIONAL DESCRIPTIVE      *
*     INFORMATION MAY BE INCLUDED TO DESCRIBE THE CASE IN MORE   *
*     DETAIL.  THIS INFORMATION WILL APPEAR ONLY ONCE, IN THE    *
*     LISTING OF THE INPUT DATA AND MAY BE ENTERED OR DELETED    *
*     DEPENDING UPON THE CONTROL WORD OPTIONS ENTERED BY THE     *
*     FOLLOWING ITEM.                                            *
*                                                                *
*                                                                *
*  3. ... KTITLE = 0      DO NOT ENTER ADDITIONAL INFORMATION    *
*     .                   DESCRIBING THE CASE.                   *
*     .                                                          *
*     .         ≥1        ENTER KTITLE ADDITIONAL CARDS          *
*     ...                 DESCRIBING THE CASE.                   *
*                                                                *
*     FORMAT = (1I4).  NUMBER OF CARDS IS 1.                     *
*                                                                *
*     DATA ARE ENTERED BY SUBROUTINE FOP.                        *
*                                                                *
******************************************************************
*                                                                *
*  4. ... LOGIC ITEM          *** NO DATA ***                    *
*     .                                                          *
*     .                   IF ADDITIONAL INFORMATION IS TO BE     *
*     .                   ENTERED (KTITLE LARGER THAN ZERO)      *
*     .                   ENTER THE FOLLOWING ITEM, OTHERWISE    *
*     ...                 (KTITLE = 0) OMIT THIS ITEM.           *
*                                                                *
******************************************************************
*                                                                *
*     REPEAT THE FOLLOWING ITEM FOR K = 1,...., KTITLE.          *
*                                                                *
*  5. ... TITLE           ADDITIONAL INFORMATION DESCRIBING      *
*     ...                 THE CASE.                              *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*     FORMAT = (18A4).  NUMBER OF CARDS IS KTITLE.                    *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE FOP.                             *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*        ALL CLUE VALUES INCLUDING ZEROS MAY BE ENTERED IF THE        *
*     USER SO DESIRES.  IF THIS APPROACH IS TAKEN A CARD              *
*     CONTAINING ONLY ZEROES SHOULD NOT BE INCLUDED AS DATA.          *
*      IF THE USER WISHES TO MINIMIZE THE AMOUNT OF DATA, HE          *
*     MAY ENTER ONLY NON-ZERO CLUE VALUES ACCORDING TO THE            *
*     PROCEDURE DISCUSSED IN 'CONTROL WORD OPTION' SECTION.           *
*      REGARDLESS OF WHICH APPROACH IS TAKEN THE LAST NON-ZERO        *
*     VALUE ON THE LAST CARD MUST BE PRECEDED BY A NEGATIVE           *
*     SIGN.                                                           *
*                                                                     *
*  6. ... KLUE( 1) =  0  DUMMY VARIABLE.                              *
*     .                                                               *
*     .   KLUE( 2) =  0  DUMMY VARIABLE.                              *
*     .                                                               *
*     .   KLUE( 3) =  0  DO NOT PERFORM VIBRATION ANALYSIS.           *
*     .            =  3  PERFORM VIBRATION ANALYSIS.                  *
*     .                                                               *
*     .   KLUE( 4) =  0  DO NOT PERFORM FLUTTER ANALYSIS.             *
*     .            =  4  PERFORM FLUTTER ANALYSIS.                    *
*     .                                                               *
*     .   KLUE( 5) =  0  DUMMY VARIABLE.                              *
*     .                                                               *
*     .   KLUE( 6) =  0  DUMMY VARIABLE.                              *
*     .                                                               *
*     .   KLUE( 7) =  0  DO NOT ENTER FLUTTER OPTIMIZATION            *
*     .                  MODULE, AFOM.                                *
*     .            =  7  ENTER FLUTTER OPTIMIZATION MODULE,           *
*     .                  AFOM. THIS IS REQUIRED IF FLUTTER            *
*     .                  VELOCITY DERIVATIVES ARE TO BE               *
*     .                  COMPUTED OR FLUTTER REDESIGN IS TO           *
*     .                  BE PERFORMED. NOTE THAT KLUE(3) AND          *
*     .                  KLUE(4) MUST BE ON IF KLUE(7) = 7.           *
*     .                                                               *
*     .   KLUE( 8) =  0  RESULTS ARE NOT TO BE INCLUDED IN A          *
*     .                  REPORT.                                      *
*     .            =  8  RESULTS ARE TO BE INCLUDED IN A              *
*     .                  REPORT.                                      *
*     .                  THE RESULTS ARE LISTED IN A FORMAT           *
*     .                  SUITABLE FOR A REPORT, THAT IS, AN           *
*     .                  EIGHT AND ONE HALF BY ELEVEN PAPER.          *
*     .                                                               *
*     .   KLUE( 9) =  0  DO NOT LIST LABELS OF FILES                  *
*     .                  GENERATED BY DSIO AND FSIO (DISK             *
*     .                  AND FORTRAN SEQUENTIAL                       *
*     .                  INPUT/OUTPUT).                               *
```

```
 ITEM       DATA                DESCRIPTION
 ----       ----                -----------

*       .               =  9   LIST LABELS OF FILES GENERATED BY        *
*       .                      DSIO AND FSIO (DISK AND FORTRAN          *
*       .                      SEQUENTIAL INPUT/OUTPUT). PROVIDES       *
*       .                      A RECORD OF PERMANENT FILES THAT         *
*       .                      ARE BEING SAVED AT THE END OF THIS       *
*       .                      RUN.                                     *
*       .                                                               *
*       .   KLUE(10) =  0      DO NOT LIST MESSAGES UPON ENTERING       *
*       .                      AND LEAVING SUBROUTINES.                 *
*       .            = 10      LIST MESSAGES UPON ENTERING AND          *
*       .                      LEAVING SUBROUTINES.                     *
*       .                                                               *
*       .   KLUE(11) =  0      DO NOT LIST MAIN HEADING.                *
*       .            = 11      LIST MAIN HEADING ENTERED AS CARD        *
*       .                      DATA AND CONSISTING OF TWO CARDS.        *
*       .                                                               *
*       .   KLUE(12) =  0      DO NOT LIST SUBHEADING IN EACH           *
*       .                      ANALYSIS MODULE.                         *
*       .            = 12      LIST SUBHEADING ENTERED AS CARD          *
*       .                      DATA AND CONSISTING OF ONE CARD.         *
*       .                                                               *
*       .   KLUE(13) =  0      DO NOT LIST INTERMEDIATE LABEL           *
*       .                      INFORMATION.                             *
*       .            = 13      LIST INTERMEDIATE LABEL                  *
*       .                      INFORMATION.  REQUIRED FOR               *
*       .                      DEBUGGING ONLY.                          *
*       .                                                               *
*       .   KLUE(14) =  0      DO NOT LIST COMPUTER TIMES.              *
*       .            = 14      LIST COMPUTER TIMES AT INTERVALS         *
*       .                      DURING PROGRAM EXECUTION.                *
*       .                                                               *
*       .   KLUE(15) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(16) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(17) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(18) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(19) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(20) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(21) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(22) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(23) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(24) =  0      DUMMY VARIABLE.                          *
*       .                                                               *
*       .   KLUE(25) =  0      DUMMY VARIABLE.                          *
```

ITEM	DATA	DESCRIPTION
* .	KLUE(26) = 0	THIS IS THE INITIAL INSTANCE IN WHICH DATA ARE BEING PASSED FROM THE SOP PROGRAM TO THE FOP PROGRAM.
* .	= 26	THIS IS NOT THE FIRST TIME DATA HAVE BEEN PASSED FROM SOP TO FOP. NOTE THAT WHEN KLUE(26) = 26, THE REMAINING CLUES (EXCEPT FOR KLUE 32, 33, 34) MUST HAVE THE SAME VALUES THEY HAD FOR KLUE(26) = 0.
* .	KLUE(27) = 0	VIBRATION ANALYSIS WILL USE THE STIFFNESS MATRIX COMPUTED IN SOP.
* .	= 27	VIBRATION ANALYSIS WILL USE THE FLEXIBILITY MATRIX COMPUTED IN SOP.
* .	KLUE(28) = 0	THE INITIAL DYNAMIC MASS MATRIX IS PROVIDED BY THE USER. (DATA IS SUPPLIED BY USER WHEN KLUE(26) = 0). IF KLUE(28) = 0, OMIT KLUE(29) AND KLUE(30).
* .	= 28	USE THE FULLY AUTOMATED MASS OPTION TO COMPUTE THE DYNAMIC MASS MATRIX.
* .	KLUE(29) = 0	THERE ARE NO (USER-SUPPLIED) FIXED MASS ITEMS TO BE CONSIDERED IN THE FULLY AUTOMATED MASS OPTION. IF KLUE(29) = 0, OMIT KLUE(30).
* .	= 29	FIXED MASS ITEMS ARE TO BE CONSIDERED IN THE FULLY AUTOMATED MASS OPTION. (THE ITEMS WILL BE SUPPLIED BY THE USER WHEN KLUE(26) = 0).
* .	KLUE(30) = 0	IN THE FULLY AUTOMATED MASS OPTION, THE USER-SUPPLIED FIXED MASS ITEMS DO NOT CONTRIBUTE TO THE OFF-DIAGONAL TERMS OF THE STRUCTURAL MASS MATRIX.
* .	= 30	THE USER-SUPPLIED FIXED MASS ITEMS IN THE FULLY AUTOMATED MASS OPTION DO CONTRIBUTE TO THE OFF-DIAGONAL TERMS OF THE STRUCTURAL MASS-MATRIX.
* .	KLUE(31) = 0	THERE ARE NO MASS BALANCE VARIABLES CONSIDERED IN THE PROBLEM. IF KLUE(31) = 0, OMIT KLUE(32).
* .	= 31	MASS BALANCE VARIABLES ARE PRESENT IN THE PROBLEM. (THE INITIAL MASS-BALANCE DATA WILL BE SUPPLIED BY THE USER WHEN KLUE(26) = 0).

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*      .   KLUE(32) =   0   DO NOT SUPERSEDE EXISTING MASS              *
*      .                    BALANCE DATA WITH NEW DATA.                 *
*      .            = 32    NEW MASS BALANCE DATA ARE BEING             *
*      .                    SUPPLIED TO OVERIDE EXISTING DATA.          *
*      .                    NOTE THAT KLUE(32) IS IGNORED BY            *
*      .                    THE PROGRAM IF KLUE(26) = 0.                *
*      .                                                                *
*      .   KLUE(33) =   0   IN THE MOST RECENT SOP STEP, THAT           *
*      .                    PROGRAM WAS USED SIMPLY TO COMPUTE          *
*      .                    THE DYNAMIC FLEXIBILITY MATRIX OR           *
*      .                    THE STRUCTURAL STIFFNESS MATRIX.            *
*      .                    THAT IS, SOP WAS NOT USED TO                *
*      .                    ANALYZE OR REDESIGN.                        *
*      .            = 33     IN THE LAST PASS THROUGH SOP, THAT         *
*      .                    PROGRAM DID ANALYZE OR REDESIGN THE         *
*      .                    STRUCTURE.                                  *
*      .                                                                *
*      .   KLUE(34) =   0   COMPUTE FLUTTER VELOCITY                    *
*      .                    DERIVATIVES FOR ALL STRUCTURAL              *
*      .                    MEMBERS AND MASS BALANCE VARIABLES,         *
*      .                    BUT DO NOT REDESIGN THE STRUCTURE           *
*      .                    FOR FLUTTER.                                *
*      .            = 34    COMPUTE FLUTTER VELOCITY                    *
*      .                    DERIVATIVES ONLY FOR FLUTTER                *
*      .                    REDESIGN VARIABLES (SEE KLUE(36)),          *
*      .                    PERFORM FLUTTER REDESIGN(S), AND            *
*      .                    PREPARE THE OUTPUT TAPES REQUIRED           *
*      .                    FOR SUBSEQUENT USE BY THE SCP AND           *
*      .                    FOP PROGRAMS.  NOTE THAT KLUE(34)           *
*      .                    IS IGNORED BY THE PROGRAM IF                *
*      .                    KLUE(7) = 0.                                *
*      .                                                                *
*      .   KLUE(35) =   0   THERE ARE NO NON-OPTIMUM WEIGHT             *
*      .                    FACTORS IN THE PROBLEM.                     *
*      .            = 35    NON-OPTIMUM WEIGHT FACTORS ARE              *
*      .                    PRESENT IN THE PROBLEM.  THESE              *
*      .                    FACTORS ARE TO BE SUPPLIED BY THE           *
*      .                    USER WHEN KLUE(26) = 0.                     *
*      .                                                                *
*      .   KLUE(36) =   0   DO NOT EXCLUDE ANY STRUCTURAL               *
*      .                    MEMBERS FROM THE FLUTTER REDESIGN           *
*      .                    PROCESS.                                    *
*      .            = 36    EXCLUDE SPECIFIED STRUCTURAL                *
*      .                    MEMBERS FROM THE FLUTTER REDESIGN           *
*      .                    PROCESS.  THE ASSOCIATED DATA MUST          *
*      .                    BE SUPPLIED WHEN KLUE(26) = 0. IF           *
*      .                    KLUE(7) = 0 OR KLUE(34) = 0 THIS            *
*      .                    DATA IS BEING ENTERED BY THE USER           *
*      .                    FOR HIS CONVENIENCE AND WILL NOT BE         *
*      .                    USED IN THIS RUN.                           *
*      .                                                                *
*      .   KLUE(37) =   0   CANTILEVER WING VIBRATION ANALYSIS          *
```

```
ITEM      DATA               DESCRIPTION
----      ----               -----------

*      .                     TO BE PERFORMED IN AVAM.                    *
*      .              = 37   FREE FREE WING VIBRATION ANALYSIS           *
*      ...                   TO BE PERFORMED IN AVAM.                    *
*                                                                        *
*     FORMAT = (10I4).  NUMBER OF CARDS IS 4 OR LESS DEPENDING           *
*     ON THE NUMBER OF CONTROL OPTIONS ENTERED AS DATA.                  *
*                                                                        *
*     DATA ARE ENTERED BY SUBROUTINE FOP THROUGH THE                     *
*     SUBROUTINE CLUES.                                                  *
*                                                                        *
**************************************************************************
```

```
ITEM      DATA               DESCRIPTION
----      ----               -----------

********************************************************************
*                                                                  *
*                                                                  *
*               AVAM - AUTOMATED VIBRATION ANALYSIS MODULE         *
*               ------------------------------------------         *
*                                                                  *
*      I.  PREPARATION OF CARD DATA                                *
*      ----------------------------                                *
*                                                                  *
*        CARD INPUT DATA MUST ALWAYS BE ENTERED FOR THE MAIN       *
*      PROGRAM. REMAINING DATA WILL DEPEND UPON THE OPTIONS THE    *
*      USER IS EXERCISING.                                         *
*                                                                  *
*      THE VIBRATION ANALYSIS IS CAPABLE OF ACCEPTING EITHER A     *
*      STIFFNESS OR FLEXIBILITY MATRIX.                            *
*                                                                  *
********************************************************************
*                                                                  *
*  1. ... VA00              IDENTIFIES THE BEGINNING OF THE        *
*      .                    CARD INPUT DATA TO THE AUTOMATED       *
*      .                    VIBRATION ANALYSIS MODULE (AVAM).      *
*      ...                  MUST BE ENTERED AS SHOWN.              *
*                                                                  *
*      USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE     *
*      AND REFERENCE PAGE NUMBER APPEARING IN THE TABLE OF         *
*      CONTENTS AT THE END OF EACH EXECUTION.  REMAINING           *
*      COLUMNS (FIVE TO SEVENTY TWO) MAY BE USED FOR ANY           *
*      DESCRIPTIVE INFORMATION THE USER WISHES TO INCLUDE.         *
*                                                                  *
*      |----------|                                                *
*      |0000000001|                                                *
*      |1234567890|                                                *
*      |----------|                                                *
*      |VA00|     |                                                *
*      |----L-----|                                                *
*                                                                  *
*      FORMAT = (1A4).  NUMBER OF CARDS IS 1.                      *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE AVAM AND SUBROUTINE LDB      *
*      WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE     *
*      PROPER HEADING FOR THE TABLE OF CONTENTS.                   *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*      ENTER (SIXTEEN WORDS PER CARD)                              *
*      FOR THE FOLLOWING ITEM FOR L=1,....,16.                     *
*                                                                  *
*  2. ... TSHV(L)           SUBTITLE CONSISTING OF ONE CARD.       *
*                                                                  *
*      WILL BE LISTED AFTER THE MAIN TITLE AT THE TOP OF EACH      *
*      PAGE OF THE LISTED RESULTS AND WILL BE USED TO DEFINE       *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*     THE TYPE OF VIBRATION ANALYSIS BEING PERFORMED.  THE          *
*     SUBTITLE IS INCREASED TO EIGHTEEN WORDS WITHIN THE            *
*     PROGRAMS WHERE THE LAST TWO WORDS ARE USED TO IDENTIFY        *
*     THE PROGRAM FROM WHICH RESULTS ARE LISTED.                    *
*                                                                   *
*     FORMAT = (16A4).  NUMBER OF CARDS IS 1.                       *
*                                                                   *
*     DATA ARE ENTERED BY THE SUBROUTINE AVAM.                      *
*                                                                   *
*********************************************************************
*                                                                   *
*                                                                   *
*        ALL CLUE VALUES INCLUDING ZEROS MAY BE ENTERED IF THE      *
*     USER SO DESIRES.  IF THE USER WISHES TO MINIMIZE THE          *
*     AMOUNT OF DATA, HE MAY ENTER ONLY NON-ZERO CLUE VALUES        *
*     ACCORDING TO THE PROCEDURE DISCUSSED IN 'CONTROL WORD         *
*     OPTION' SECTION.  REGARDLESS OF WHICH APPROACH IS TAKEN       *
*     THE LAST NON-ZERO VALUE (IF ANY) MUST BE PRECEDED BY A        *
*     NEGATIVE SIGN.                                                *
*                                                                   *
*  3. ... KLUEV( 1) =  0 FIXED VARIABLE, EQUAL TO ZERO.             *
*       .                                                           *
*       .  KLUEV( 2) =  0 DO NOT PLOT VIBRATION MODES ON            *
*       .                   CALCOMP.                                *
*       .            =  2 PLOT VIBRATION MODES ON CALCOMP.          *
*       .                                                           *
*       .  KLUEV( 3) =  0 DO NOT LIST FLEXIBILITY (NOR              *
*       .                   STIFFNESS) MATRIX.                      *
*       .            =  3 LIST FLEXIBILITY (OR STIFFNESS)           *
*       .                   MATRIX.                                 *
*       .                                                           *
*       .  KLUEV( 4) =  0 DO NOT LIST DYNAMIC MASS MATRIX.          *
*       .            =  4 LIST DYNAMIC MASS MATRIX.                 *
*       .                                                           *
*       .  KLUEV( 5) =  0 DO NOT LIST ALL MASS MATRICES             *
*       .                   GENERATED WITHIN THE PROGRAM WHEN       *
*       .                   COMPUTING THE DYNAMIC MASS MATRIX.      *
*       .                    FOR EXAMPLE, IF KLUE(26) = 26 AND      *
*       .                   KLUE(28) = 0, THE CURRENT DYNAMIC       *
*       .                   MASS MATRIX IS THE SUM OF THE           *
*       .                   INITIAL DYNAMIC MASS MATRIX             *
*       .                   (SUPPLIED ON CARDS WHEN KLUE(26) =      *
*       .                   0) AND AN INCREMENTAL MASS MATRIX       *
*       .                   ASSOCIATED WITH ALL THE CUMULATIVE      *
*       .                   REDESIGN ACCOMPLISHED TO THIS POINT     *
*       .                   BY SOP AND FOP. THIS INCREMENTAL        *
*       .                   MATRIX WILL NOT BE LISTED IF            *
*       .                   KLUEV(5) = 0.                           *
*       .            =  5 LIST ALL MASS MATRICES GENERATED          *
*       .                   WITHIN THE PROGRAM WHEN COMPUTING       *
*       .                   THE DYNAMIC MASS MATRIX.                *
*       .
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*     .   KLUEV( 6) =  0 DO NCT LIST THE TRANSFORMATION          *
*     .                  MATRIX, B, BETWEEN STRUCTURAL AND        *
*     .                  DYNAMIC DISPLACEMENTS.                   *
*     .             =  6 IF COMPUTED, LIST TRANSFORMATION         *
*     ...                MATRIX, B.                               *
*                                                                 *
*     FORMAT = (10I4).  NUMBER OF CARDS IS 1. NOTE THAT THE       *
*     LAST CARD CONTAINS THE LAST OPTION WHICH IS INDICATED BY    *
*     A NEGATIVE NUMBER. IF ALL CLUES ARE 0, NO NEGATIVE SIGN     *
*     IS USED.                                                    *
*                                                                 *
*     DATA ARE ENTERED BY THE SUBROUTINE AVAM THROUGH THE         *
*     SUBROUTINE CLUES.                                           *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*     A.  MASS (WEIGHTS, UNBALANCES, AND INERTIAS)                *
*     --------------------------------------------                *
*                                                                 *
*                                                                 *
*     A BRIEF DISCUSSION OF THE MASS DATA IS GIVEN IN THE         *
*     'PROGRAM APPLICATION' SECTION.                              *
*                                                                 *
*******************************************************************
*                                                                 *
*  4. ... LOGIC ITEM          *** NO DATA ***                     *
*                                                                 *
*                                                                 *
*     IF THIS IS THE FIRST TIME WHEN DATA ARE PASSED FROM SOP     *
*     TO FOP (KLUE(26) = 0) ENTER THE FOLLOWING THIRTEEN          *
*     ITEMS, OTHERWISE (KLUE(26) = 26) OMIT THESE ITEMS (5 -      *
*     17).                                                        *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*     1.  NON-OPTIMUM WEIGHT FACTORS AND/OR EXCLUSION OF          *
*     ----------------------------------------------------        *
*         SELECTED STRUCTURAL MEMBERS FROM THE FLUTTER            *
*         --------------------------------------------            *
*         REDESIGN PROCESS.                                       *
*         ----------------                                        *
*                                                                 *
*******************************************************************
*                                                                 *
*  5. ... LOGIC ITEM          *** NO DATA ***                     *
*                                                                 *
*     IF NON-OPTIMUM FACTORS ARE TO BE PRESENT IN THE PROBLEM,    *
*     (KLUE(35) = 35), AND/OR SELECTED STRUCTURAL MEMBERS ARE     *
*     TO BE EXCLUDED FROM THE FLUTTER REDESIGN PROCESS,           *
*     (KLUE(36) = 36), ENTER THE FOLLOWING ITEM.  OTHERWISE,      *
```

```
*     (KLUE(35) = 0 AND KLUE(36) = 0), OMIT THIS ITEM.                   *
*                                                                        *
**************************************************************************
*                                                                        *
*     REPEAT THE FOLLOWING ITEM                                          *
*     FOR EACH NON-OPTIMUM FACTOR                                        *
*     UNTIL A BLANK CARD IS ENCOUNTERED.                                 *
*                                                                        *
*     ENTER (FOUR GROUPS OR LESS PER CARD) FOR I = 1,....,4              *
*                                                                        *
*  6. ... MUMJ(I)          STRUCTURAL MEMBER NUMBER FOR WHICH            *
*     .                    EXCLUSION CLUE AND/OR NON-OPTIMUM             *
*     .                    WEIGHT FACTOR IS BEING PRESCRIBED.            *
*     .                                                                  *
*     .   IDJ(I) = 0       INCLUDE STRUCTURAL MEMBER MUMJ(I)             *
*     .                    IN THE FLUTTER REDESIGN PROCESS.              *
*     .          = 1       EXCLUDE STRUCTURAL MEMBER MUMJ(I)             *
*     .                    FROM THE FLUTTER REDESIGN PROCESS.            *
*     .                                                                  *
*     .   FACTJ(I)         NON-OPTIMUM WEIGHT FACTOR                     *
*     .                    ASSOCIATED WITH STRUCTURAL MEMBER             *
*     ...                  MUMJ(I).                                      *
*                                                                        *
*     FOR EXAMPLE IF FACTJ(I) = 1.2, THE TRUE INCREMENTAL                *
*     WEIGHT OF ELEMENT MUMJ(I) DURING REDESIGN WOULD BE TAKEN           *
*     TO BE TWENTY PERCENT LARGER THAN THE COMPUTED                      *
*     INCREMENTAL STRUCTURAL WEIGHT OF THE ELEMENT.  NOTE THAT           *
*     IF FACTJ(I) = 0.0, A DEFAULT VALUE OF UNITY IS USED                *
*     WITHIN THE PROGRAM.  ALSO, IF THE FULLY-AUTOMATED MASS             *
*     OPTION IS BEING USED (KLUE(28) = 28), FACTJ(I) IS                  *
*     APPLIED TO THE TOTAL STRUCTURAL WEIGHT OF ELEMENT                  *
*     MUMJ(I) - NOT JUST TO THE INCREMENTAL WEIGHT BEYOND THE            *
*     INITIAL DESIGN                                                     *
*                                                                        *
*     NOT ALL STRUCTURAL MEMBERS NEED BE REPRESENTED IN THE              *
*     DATA.  THUS IF A STRUCTURAL MEMBER IS NOT PRESENT IN THE           *
*     DATA, THE FOP PROGRAM ASSUMES IT IS TO BE INCLUDED IN              *
*     THE FLUTTER REDESIGN PROCESS, AND THAT IT HAS NO                   *
*     NON-OPTIMUM FACTOR.  ALSO, MEMBERS REPRESENTED IN THE              *
*     DATA NEED NOT BE IN ANY PARTICULAR ORDER.                          *
*                                                                        *
*     FORMAT = (4(2I5,F10.3)). NUMBER OF CARDS IS DEFINED BY A           *
*     BLANK CARD AT THE END OF THE NON-OPTIMUM FACTORS DATA.             *
*                                                                        *
*     DATA ARE ENTERED BY SUBROUTINE READY.                              *
*                                                                        *
**************************************************************************
*                                                                        *
*                                                                        *
*     2.  MASS BALANCE DATA                                              *
*     ---------------------                                              *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*****************************************************************
*                                                               *
*  7. ... LOGIC ITEM          *** NO DATA ***                   *
*                                                               *
*     IF MASS BALANCE VARIABLES ARE TO BE PART OF THE PROBLEM,  *
*     (KLUE(31) = 31), ENTER THE FOLLOWING ITEM.  OTHERWISE,    *
*     (KLUE(31) = 0), OMIT THIS ITEM.                           *
*                                                               *
*****************************************************************
*                                                               *
*     NOTE THERE IS A LIMIT OF TWENTY MASS BALANCE VALUES.      *
*                                                               *
*     REPEAT THE FOLLOWING ITEM                                 *
*     FOR EACH MASS BALANCE SET                                 *
*     UNTIL A BLANK CARD IS ENCOUNTERED.                        *
*                                                               *
*  8. ... I1              ARBITRARY IDENTIFICATION NUMBER OF    *
*     .                   MASS BALANCE VARIABLE.                *
*     .                                                         *
*     .   A1              INITIAL WEIGHT OF MASS BALANCE I1,    *
*     .                   LB.                                   *
*     .                                                         *
*     .   J1(K),K=1,3     X, Y, AND Z STRUCTURAL DEGREE OF      *
*     .                   FREEDOM NUMBERS FOR STRUCTURAL NODE   *
*     .                   AT WHICH MASS BALANCE I1 IS           *
*     ...                 LOCATED.                              *
*                                                               *
*     IF MASS BALANCE I1 IS GIVEN INITIAL WEIGHT A1 = 0.0, IT   *
*     WILL OF COURSE HAVE NO EFFECT ON THE PROBLEM.  HOWEVER,   *
*     THE VARIABLE WILL BE CARRIED ALONG BY THE FOP PROGRAM     *
*     AND CAN (IF DESIRED) EVENTUALLY BE GIVEN A NEW WEIGHT BY  *
*     INVOKING THE OPTION KLUE(32) = 32.                        *
*                                                               *
*     FORMAT (I5,F15.5,3I5). NUMBER OF CARDS IS DEFINED BY A    *
*     BLANK CARD AT THE END OF THE MASS BALANCE DATA.           *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE READY.                     *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*     3.  MASS AND WEIGHT DATA                                  *
*     ------------------------                                  *
*                                                               *
*****************************************************************
*                                                               *
*  9. ... LOGIC ITEM          *** NO DATA ***                   *
*                                                               *
*     IF THE FULLY AUTOMATED MASS OPTION IS CALLED (KLUE(28) =  *
*     28) OMIT THE FOLLOWING TWO ITEMS AND GO TO ITEM 12. OMIT  *
*     THE FOLLOWING ITEM IF KLUE(7) = 0 OR KLUE(34) = 0.        *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*****************************************************************
*                                                               *
* 10. ... WINITT            TOTAL INITIAL WEIGHT OF THE         *
*         .                 STRUCTURE INCLUDING NON-OPTIMUM     *
*         .                 FACTORS AND FIXED MASS ITEMS, BUT   *
*         ...               EXCLUDING MASS BALANCE, IF ANY.     *
*                                                               *
*     FORMAT = (E15.5). NUMBER OF CARDS IS 1.                   *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE DYNMAS.                    *
*                                                               *
*****************************************************************
*                                                               *
*                                                               *
*     4.  DYNAMIC MASS MATRIX                                   *
*     -----------------------                                   *
*                                                               *
*     REPEAT THE FOLLOWING ITEM                                 *
*     UNTIL A BLANK CARD IS ENCOUNTERED.                        *
*                                                               *
*     ENTER (THREE GROUPS OR LESS PER CARD) FOR K = 1,....,3    *
*                                                               *
* 11. ... NR(K)             ROW NUMBER OF DYNAMIC MASS MATRIX   *
*         .                 ELEMENT.                            *
*         .                                                     *
*         .  NC(K)          COLUMN NUMBER OF DYNAMIC MASS       *
*         .                 MATRIX ELEMENT.                     *
*         .                                                     *
*         .  WW(K)          VALUE OF DYNAMIC MASS MATRIX        *
*         .                 ELEMENT (WEIGHT                     *
*         ...               UNITS-I.E.,LB,IN-LB, IN.SQ-LB)      *
*                                                               *
*     THIS MASS MATRIX DATA IS SPECIFIED FOR LOWER TRIANGLE     *
*     ONLY AND MUST BE IN ROW SORT, THAT IS, THE ELEMENTS OF    *
*     ROW N MUST FOLLOW THOSE OF ROW (N-1) AND PRECEDE THOSE    *
*     OF ROW (N+1). IF THESE REQUIREMENTS ARE VIOLATED, THE     *
*     FOP PROGRAM WILL PRINT THE APPROPRIATE MESSAGE AND        *
*     EXECUTION WILL STOP.                                      *
*     THE ELEMENTS OF THE DYNAMIC MASS MATRIX SHOULD REFLECT    *
*     THE PRESENCE OF ANY MASS BALANCE ENTERED IN ITEM 8.       *
*                                                               *
*     FORMAT = (3(2I4,F15.5,1X)). NUMBER OF CARDS IS DEFINED    *
*     BY A BLANK CARD AT THE END OF THE DYNAMIC MASS MATRIX.    *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE DYNMAS.                    *
*                                                               *
*****************************************************************
*                                                               *
* 12. ... LOGIC ITEM              *** NO DATA ***               *
*                                                               *
*     IF THE FULLY AUTOMATED MASS OPTION IS NOT CALLED,         *
*     (KLUE(28) = 0), OR IF (KLUE(28) = 28), BUT THE USER DOES  *
```

```
*     NOT WISH TO SUPPLY FIXED MASS ITEMS. (KLUE(29) = 0),        *
*     OMIT THE FOLLOWING THREE ITEMS.                             *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*       WHEN THE FULLY AUTOMATED MASS OPTION IS USED, INITIAL     *
*     MASS DATA IS FIRST COMPUTED IN THE STRUCTURES GRID.         *
*      THUS THE TOTAL NUMBER OF ROWS AND COLUMNS OF THE           *
*     STRUCTURAL MASS MATRIX WILL BE EQUAL TO THE TOTAL NUMBER    *
*     OF STRUCTURAL DEGREES OF FREEDOM.  THE USER IS CAUTIONED    *
*     THAT THE AUTOMATED MASS ROUTINE ONLY CALCULATES MASSES      *
*     CORRESPONDING TO TRANSLATIONAL DEGREES OF FREEDOM OF THE    *
*     STRUCTURE. THUS THE INERTIA PROPERTIES ASSOCIATED WITH      *
*     ROTATIONAL DEGREES OF FREEDOM WILL BE ZERO.  (NOTE THAT     *
*     ROTATIONAL DEGREES OF FREEDOM ARE ASSOCIATED WITH BEAM      *
*     ELEMENT NODE POINTS.)                                       *
*       TO AVOID A SINGULARITY IN THE MASS MATRIX WHEN            *
*     ROTATIONAL DEGREES OF FREEDOM EXIST AND WHEN NO             *
*     REDUCTION IS BEING ACCOMPLISHED BETWEEN THE STRUCTURES      *
*     AND DYNAMICS MODELS (KLUE(27) = 0), THE USER MUST ENTER     *
*     APPROPRIATE INERTIA TERMS IN ITEM 15, BELOW.                *
*       WHEN REDUCTION IS BEING ACCOMPLISHED (KLUE(27) = 27),     *
*     THE STRUCTURAL MASS MATRIX WILL BE TRANSFORMED TO THE       *
*     DYNAMICS GRID. IN THIS PROCESS, THE USER MAY ELIMINATE      *
*     ANY ROTATIONAL DEGREES OF FREEDOM OF THE STRUCTURE THAT     *
*     ARE NOT REQUIRED FOR THE DYNAMICS MODEL.                    *
*                                                                 *
*******************************************************************
*                                                                 *
* 13. ... LOGIC ITEM          *** NO DATA ***                     *
*                                                                 *
*     OMIT THE FOLLOWING ITEM IF FLUTTER REDESIGN IS NOT          *
*     CALLED, THAT IS IF KLUE(7) = 0 OR KLUE(34) = 0.             *
*                                                                 *
*******************************************************************
*                                                                 *
*     FIXED WEIGHT                                                *
*     ------------                                                *
*                                                                 *
* 14. ... WFIX                TOTAL WEIGHT OF FIXED MASS ITEMS,   *
*     ...                     LB.                                 *
*                                                                 *
*     FORMAT = (E15.5). NUMBER OF CARDS IS 1.                     *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE DYNMAS.                      *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*     5.  FIXED MASS MATRIX                                       *
*     ---------------------                                       *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*        THE FIXED MASSES ENTERED IN THIS ITEM MUST CORRESPOND     *
*       TO THE DEGREES OF FREEDOM OF THE STRUCTURES MODEL.         *
*        MASS, MASS UNBALANCE, OR INERTIA TERMS MAY BE ENTERED     *
*       AT STRUCTURAL NODE POINTS FOR ANY MASS ITEM IN THE         *
*       LIFTING SURFACE NOT REPRESENTED BY THE FINITE-ELEMENT      *
*       MODEL.                                                     *
*                                                                  *
*       REPEAT THE FOLLOWING ITEM                                  *
*       UNTIL A BLANK CARD IS ENCOUNTERED.                         *
*                                                                  *
*       ENTER (THREE GROUPS OR LESS PER CARD) FOR K = 1,....,3     *
*                                                                  *
* 15. ... NR(K)             ROW NUMBER OF STRUCTURAL MASS          *
*       .                   MATRIX ELEMENT.                        *
*       .                                                          *
*       .  NC(K)            COLUMN NUMBER OF STRUCTURAL MASS       *
*       .                   MATRIX ELEMENT.                        *
*       .                                                          *
*       .  WW(K)            VALUE OF STRUCTURAL MASS MATRIX        *
*       .                   ELEMENT (WEIGHT UNITS-I.E..LB,         *
*       ...                 IN-LB,IN.SQ-LB)                        *
*                                                                  *
*       THE FOP PROGRAM CAN ACCEPT AS MANY AS 183 GROUPS OF        *
*       NR(K), NC(K), AND WW(K). DATA MUST, HOWEVER, BE SUPPLIED   *
*       FOR THE FULL MATRIX - NOT JUST THE LOWER TRIANGLE.         *
*        ALSO, THE DATA MUST BE SUPPLIED IN ROW SORT, THAT IS,     *
*       THE ELEMENTS OF ROW N MUST FOLLOW THOSE OF ROW (N-1) AND   *
*       PRECEDE THOSE OF ROW (N+1).                                *
*                                                                  *
*       FORMAT = (3(2I4,F15.5,1X)). NUMBER OF CARDS IS DEFINED     *
*       BY A BLANK CARD AT THE END OF THE FIXED MASS MATRIX        *
*       DATA.                                                      *
*                                                                  *
*       DATA ARE ENTERED BY SUBROUTINE DYNMAS.                     *
*                                                                  *
********************************************************************
*                                                                  *
* 16. ... LOGIC ITEM            *** NO DATA ***                    *
*                                                                  *
*                                                                  *
*       IF A FREE FREE WING IS BEING ANALYZED (KLUE(37) = 37)      *
*       ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE (KLUE(37) =   *
*       0) OMIT THIS ITEM.                                         *
*                                                                  *
********************************************************************
*                                                                  *
*                                                                  *
*       6.  PLUG MASS MATRIX                                       *
*       --------------------                                       *
*                                                                  *
*       DATA FOR THE PLUG MASS MATRIX ENTERED IN THIS ITEM MUST    *
*       BE CONSISTENT WITH THE TYPE OF FREE-FREE MOTION            *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*      SPECIFIED IN THE INITIAL SOP RUN.  THUS IF SYMMETRIC          *
*      MOTION WAS SPECIFIED (SEE KLUE(23) TO KLUE(25) IN SOP -       *
*      PART B OF VOLUME II), THE PLUG HAS (AT MOST) THE              *
*      FOLLOWING THREE DEGREES OF FREEDOM.                           *
*                                                                    *
*        1. X          (FORE -AFT TRANSLATION)                       *
*        2. Z          (VERTICAL TRANSLATION)                        *
*        3. THETAY     (PITCH ROTATION)                              *
*                                                                    *
*      FOR ANTI-SYMMETRIC MOTION (SEE KLUE(20) TO KLUE(22) IN        *
*      SOP - PART B OF VOLUME II) THE PLUG HAS  (AT MOST) THE        *
*      FOLLOWING THREE DEGREES OF FREEDOM.                           *
*                                                                    *
*        1. Y          (LATERAL TRANSLATION)                         *
*        2. THETAX     (ROLL ROTATION)                               *
*        3. THETAZ     (YAW ROTATION)                                *
*                                                                    *
*      THUS THE PLUG MASS MATRIX IS A 3 X 3 MATRIX UNLESS ONE        *
*      OR MORE OF THE THREE POSSIBLE DEGREES OF FREEDOM WAS          *
*      ELIMINATED IN THE INITIAL SOP RUN.  FOR EXAMPLE, A 2 X 2      *
*      MATRIX IS REQUIRED IF THE FORE-AFT DEGREE OF FREEDOM HAD      *
*      BEEN ELIMINATED FROM SYMMETRIC MOTION.                        *
*                                                                    *
*      REPEAT THE FOLLOWING ITEM                                     *
*      UNTIL A BLANK CARD IS ENCOUNTERED.                            *
*                                                                    *
*      ENTER (THREE GROUPS OR LESS PER CARD) FOR K =1,....,3         *
*                                                                    *
* 17.  ... NR(K)             ROW NUMBER OF PLUG MASS MATRIX          *
*      .                     ELEMENT.                                *
*      .                                                             *
*      .   NC(K)             COLUMN NUMBER OF PLUG MASS MATRIX       *
*      .                     ELEMENT.                                *
*      .                                                             *
*      .   WW(K)             VALUE OF PLUG MASS MATRIX ELEMENT       *
*      .                     (WEIGHT UNITS- I. E. LB, IN-LB,         *
*      ...                   IN**2-LB).                              *
*                                                                    *
*      THIS DATA NEED ONLY BE SPECIFIED FOR LOWER TRIANGLE.          *
*                                                                    *
*      FORMAT = ( 3(2I4, F15.5, 1X) ).  NUMBER OF CARDS IS           *
*      DEFINED BY A BLANK CARD AT THE END OF THE PLUG MASS           *
*      MATRIX.                                                       *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE FFMASS.                        *
*                                                                    *
**********************************************************************
*                                                                    *
*                                                                    *
*      7.  SUPERSEDE EXISTING MASS BALANCE DATA                      *
*      ----------------------------------------                      *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

***********************************************************************
*                                                                     *
* 18. ... LOGIC ITEM            *** NO DATA ***                       *
*                                                                     *
*         IF MASS BALANCE VARIABLES ARE PRESENT IN THE PROBLEM,       *
*       (KLUE(31) = 31), AND IF THE EXISTING DATA ARE TO BE           *
*       SUPERSEDED BY NEW MASS BALANCE DATA, (KLUE(32) = 32),         *
*       ENTER THE FOLLOWING ITEM.  THIS CAN ONLY BE DONE IF THIS      *
*       IS NOT THE FIRST TIME DATA ARE BEING PASSED FROM SOP TO       *
*       FOP, (KLUE(26) = 26).  OMIT THIS ITEM IF KLUE(26) = 0,        *
*       OR KLUE(31) = 0, OR KLUE(32) = 0.                             *
*                                                                     *
***********************************************************************
*                                                                     *
*       EACH CARD CONTAINS THE TWO PIECES OF DATA NECESSARY TO        *
*       UPDATE ONE MASS BALANCE VARIABLE.  THERE MAY BE AS MANY       *
*       - BUT NOT MORE - SUCH CARDS AS THERE ARE ORIGINAL MASS        *
*       BALANCE VARIABLES IN THE PROBLEM.  THAT IS, ANY OR ALL        *
*       OF THE EXISTING VARIABLES MAY BE UPDATED, BUT NO              *
*       COMPLETELY NEW MASS BALANCE VARIABLES CAN BE INTRODUCED       *
*       HERE.                                                         *
*                                                                     *
*       REPEAT THE FOLLOWING ITEM                                     *
*       FOR EACH SUPERSEDED MASS BALANCE SET                          *
*       UNTIL A BLANK CARD IS ENCOUNTERED.                            *
*                                                                     *
* 19. ... I1                  IDENTIFICATION NUMBER OF AN             *
*     .                       EXISTING MASS BALANCE VARIABLE.         *
*     .                                                               *
*     .   A1                  NEW WEIGHT OF MASS BALANCE VARIABLE     *
*     ...                     I1, LB.                                 *
*                                                                     *
*       FORMAT = (I5,E15.5). NUMBER OF CARDS IS DEFINED BY A          *
*       BLANK CARD AT THE END OF THE SUPERSEDED MASS BALANCE          *
*       DATA.                                                         *
*                                                                     *
*       DATA ARE ENTERED BY SUBROUTINE READY.                         *
*                                                                     *
***********************************************************************
*                                                                     *
*                                                                     *
*       B.  MODAL DATA                                                *
*       --------------                                                *
*                                                                     *
*                                                                     *
* 20. ... NROOTS ≤ 20         NUMBER OF NORMAL MODES OF VIBRATION     *
*     .                       TO BE COMPUTED.                         *
*     .                                                               *
*     .   NDOFFF              NUMBER OF DISPLACEMENTS PER MODE        *
*     .                       WHICH ARE TO BE SAVED FOR USE IN        *
*     .                       THE FLUTTER ANALYSIS PART OF THE        *
*     .                       PROGRAM.                                *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*      .    NZERO ≥ 0          NUMBER OF ZERO VALUES FOR THE            *
*      .                       DISPLACEMENTS PER MODE TO BE             *
*      .                       SPECIFIED FOR USE IN THE FLUTTER         *
*      ...                     ANALYSIS PART OF THE PROGRAM.            *
*                                                                       *
*      NOTE THAT THE NUMBER OF DISPLACEMENTS STORED ON TAPE FOR         *
*      EACH VIBRATION MODE AND PASSED TO THE FLUTTER PROGRAM IS         *
*       IRCWR = NDOFFF + NZERO.                                         *
*                                                                       *
*      FORMAT = (3I4). NUMBER OF CARDS IS 1.                            *
*                                                                       *
*      DATA ENTERED BY SUBROUTINE EIGEN.                                *
*                                                                       *
*************************************************************************
*                                                                       *
*                                                                       *
*      THE TWO VARIABLES IN THE FOLLOWING ITEM REORDER AND/OR           *
*      ELIMINATE THE DISPLACEMENTS CALCULATED IN VIBRATION              *
*      ANALYSIS FOR USE IN FLUTTER ANALYSIS. FOR THE                    *
*      REQUIREMENTS ON ORDERING DISPLACEMENT DATA FOR FLUTTER           *
*      ANALYSIS SEE FIGURE 6A IN AFAM.                                  *
*                                                                       *
*                                                                       *
*      ENTER (TEN VALUES OR LESS PER CARD) AND                          *
*      REPEAT THE FOLLOWING ITEM FOR I = 1,...,NDOFFF.                  *
*                                                                       *
*                                                                       *
* 21.  ... IDFV(I) ≤ 200       DEGREE OF FREEDOM NUMBER GENERATED       *
*      .                       IN THE VIBRATION ANALYSIS.               *
*      .                                                                *
*      .    IDFF(I) ≤          CORRESPONDING DEGREE OF FREEDOM          *
*      .    NDOFFF+NZERO       NUMBER TO BE USED IN THE FLUTTER         *
*      ...                     ANALYSIS.                                *
*                                                                       *
*      NOTEO THE ROW IDENTIFICATION NUMBER FOR THE FLUTTER              *
*      ARRAY, IDFF(I), IS SEQUENCED FROM 1 TO (NDOFFF + NZERO).         *
*       THIS ITEM MUST BE SPECIFIED IN ASCENDING SEQUENCE OF            *
*      IDFF(I). OMISSION OF THIS ITEM FOR ANY VALUE OF IDFF(I)          *
*      WILL RESULT IN A ZERO DISPLACEMENT IN THE ROW OF THE             *
*      FLUTTER ARRAY CORRESPONDING TO THE OMITTED VALUE OF              *
*      IDFF(I).                                                         *
*                                                                       *
*      FORMAT = (10I4). NUMBER OF CARDS IS (NDOFFF-1)/5 + 1.            *
*                                                                       *
*      DATA ARE ENTERED BY SUBROUTINE VIBIFO.                           *
*                                                                       *
*************************************************************************
*                                                                       *
*                                                                       *
*      C.  MODAL PLOTS                                                  *
*      ---------------                                                  *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*******************************************************************
*                                                                 *
* 22. ... LOGIC ITEM           *** NO DATA ***                    *
*                                                                 *
*      IF VIBRATION MODES ARE TO BE PLOTTED (KLUEV(2) = 2)        *
*      ENTER DATA FOR THE FOLLOWING TWELVE ITEMS. OTHERWISE       *
*      (KLUEV(2) = 0) OMIT THESE ITEMS.                           *
*                                                                 *
*******************************************************************
*                                                                 *
*      ENTER (EIGHTEEN WORDS PER CARD) AND                        *
*      REPEAT THE FOLLOWING ITEM FOR I = 1.....3                  *
*                                                                 *
* 23. ... TITLE              TITLE DEFINING THE PLOTTING          *
*      .                     INFORMATION.  WILL BE LISTED AS      *
*      ...                   ENTERED ON THE THREE CARDS.          *
*                                                                 *
*      FORMAT = (18A4). NUMBER OF CARDS IS 3.                     *
*                                                                 *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                        *
*                                                                 *
*******************************************************************
*                                                                 *
* 24. ... THETA1D            ROTATION ABOUT X AXIS, DEG.          *
*      .                                                          *
*      .   THETA2D           ROTATION ABOUT Y AXIS, DEG.          *
*      .                                                          *
*      ... THETA3D           ROTATION ABOUT Z AXIS, DEG.          *
*                                                                 *
*      SEE FIGURE 2.                                              *
*                                                                 *
*      FORMAT = (3E15.5). NUMBER OF CARDS IS 1.                   *
*                                                                 *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                        *
*                                                                 *
*******************************************************************
*                                                                 *
* 25. ... NC                 NUMBER OF CARDS CONTAINING PLOTTING  *
*      ...                   GRID COORDINATES.                    *
*                                                                 *
*      FORMAT = (1I5). NUMBER OF CARDS IS 1.                      *
*                                                                 *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                        *
*                                                                 *
*******************************************************************
*                                                                 *
*      REPEAT THE FOLLOWING ITEM FOR I = 1.....NC                 *
*                                                                 *
* 26. ... NUM ≤ 800          GRID POINT NUMBER FOR PLOTTING GRID  *
*      .                     DEFINED BY USER (NUMBERED            *
*      .                     CONSECUTIVELY FROM 1 THROUGH NC).    *
```

```
 ITEM      DATA               DESCRIPTION
 ----      ----               -----------

*     .    XPRIM(1,NUM)       X COORDINATE OF PLOTTING GRID           *
*     .                       POINT, IN.                               *
*     .                                                                *
*     .    XPRIM(2,NUM)       Y COORDINATE OF PLOTTING GRID           *
*     .                       POINT, IN.                               *
*     .                                                                *
*     .    XPRIM(3,NUM)       Z COORDINATE OF PLOTTING GRID           *
*     .                       POINT, IN.                               *
*     .                                                                *
*     .    DOF(NUM)           DEGREE OF FREEDOM OF GRID POINT (X,     *
*     .                       Y, OR Z). FIELD FOR DOF(NUM) SHOULD     *
*     .                       BE BLANK FOR POINTS WITH ZERO           *
*     ...                     DISPLACEMENTS.                           *
*                                                                      *
*     FORMAT = (I5,3E15.5,1X,A4). NUMBER OF CARDS IS NC.              *
*                                                                      *
*     DATA ARE ENTERED BY PROGRAM VIBRAP.                              *
*                                                                      *
************************************************************************
*                                                                      *
* 27. ... BMREF               NAME OF REFERENCE BEAM USED TO          *
*     .                       SCALE MODAL AMPLITUDES. BEAM NAME       *
*     .                       CONSISTS OF EIGHT CHARACTERS, OR        *
*     .                       LESS, ASSIGNED BY THE USER.             *
*     .                       REFERENCE BEAM NAME SHOULD BE ONE       *
*     .                       OF NAMES IN ARRAY BNAME (ITEM 29).      *
*     .                                                                *
*     .    RATIO              RATIO OF MAXIMUM MODAL AMPLITUDE TO     *
*     ...                     REFERENCE BEAM LENGTH.                   *
*                                                                      *
*     FORMAT = (2A4,2X,E10.3). NUMBER OF CARDS IS 1.                  *
*                                                                      *
*     DATA ARE ENTERED BY PROGRAM VIBRAP.                              *
*                                                                      *
************************************************************************
*                                                                      *
* 28. ... NBEAMS ≤ 40         NUMBER OF BEAMS IN A GRID.               *
*                                                                      *
*     FORMAT = (1I5). NUMBER OF CARDS IS 1.                            *
*                                                                      *
*     DATA ARE ENTERED BY PROGRAM VIBRAP.                              *
*                                                                      *
************************************************************************
*                                                                      *
*     REPEAT THE FOLLOWING TWO ITEMS FOR I=1,...,NBEAMS.              *
*                                                                      *
************************************************************************
*                                                                      *
* 29. ... BNAME               BEAM NAMES CONSISTING OF EIGHT          *
*     .                       CHARACTERS OR LESS ASSIGNED BY THE      *
*     .                       USER.                                    *
```

```
 ITEM     DATA              DESCRIPTION
 ----     ----              -----------

*      ... NPTBM ≤ 20      NUMBER OF GRID POINTS ON A BEAM.           *
*                                                                     *
*      FORMAT = (2A4,2X,I5). NUMBER OF CARDS IS 1.                    *
*                                                                     *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                            *
*                                                                     *
***********************************************************************
*                                                                     *
*      ENTER (TEN VALUES OR LESS PER CARD) AND                        *
*      REPEAT THE FOLLOWING ITEM FOR K=1,...,NPTBM.                   *
*                                                                     *
* 30.  ... JPTS(K)          GRID POINT NUMBERS ON I'TH BEAM.          *
*                                                                     *
*      FORMAT = (10I5). NUMBER OF CARDS IS (NPTBM - 1)/10 + 1.        *
*                                                                     *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                            *
*                                                                     *
***********************************************************************
*                                                                     *
* 31.  ... NPLOTS ≤ 20      TOTAL NUMBER OF MODES TO BE               *
*      ...                  PLOTTED.                                  *
*                                                                     *
*      FORMAT = (1I5). NUMBER OF CARDS IS 1.                          *
*                                                                     *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                            *
*                                                                     *
***********************************************************************
*                                                                     *
*      ENTER (TEN VALUES OR LESS PER CARD) AND                        *
*      REPEAT THE FOLLOWING ITEM FOR I=1,...,NPLOTS.                  *
*                                                                     *
* 32.  ... MPLOT(I)         MODE NUMBERS TO BE PLOTTED.               *
*                                                                     *
*      IF ANY MODE NUMBER IS PRECEDED BY A NEGATIVE SIGN THE          *
*      DIRECTION OF MODE PLOTTED WILL BE REVERSED.                    *
*                                                                     *
*      FORMAT = (10I5). NUMBER OF CARDS IS (NPLOTS - 1)/10 + 1.       *
*                                                                     *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                            *
*                                                                     *
***********************************************************************
*                                                                     *
* 33.  ... NCDI ≤ 800       TOTAL NUMBER OF PLOTTING GRID             *
*      .                    POINTS INCLUDING MODAL DATA AND           *
*      ...                  ZERO DISPLACEMENT DATA.                   *
*                                                                     *
*      FOR EXAMPLE, MODAL DATA WOULD NOT BE AVAILABLE AT THE          *
*      ROOT POINTS IN A CANTILEVERED STRUCTURE, SINCE NO              *
*      DEGREES OF FREEDOM EXIST AT SUCH POINTS IN THE DYNAMICS        *
*      MODEL, I.E., DISPLACEMENTS ARE ZERO.  THUS IF THE USER         *
*      WISHES TO SEE HIS MODE SHAPES WITH THE SPANWISE MODAL          *
*      DISPLACEMENTS EXTENDED TO THE ROOT, HE WOULD LEAVE THOSE       *
```

```
 ITEM      DATA              DESCRIPTION
 ----      ----              -----------

*      POSITIONS BLANK IN THE ARRAY IDISP(I). (SEE ITEM BELOW)     *
*      WHICH CORRESPOND TO THE PLOTTING GRID POINTS AT THE         *
*      ROOT.                                                       *
*                                                                  *
*      FORMAT = (1I5). NUMBER OF CARDS IS 1.                       *
*                                                                  *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                         *
*                                                                  *
********************************************************************
*                                                                  *
*      ENTER (TEN VALUES OR LESS PER CARD) AND                     *
*      REPEAT THE FOLLOWING ITEM FOR I=1,...,NCDI.                 *
*                                                                  *
* 34.  ... IDISP(I)         DEGREE OF FREEDOM IN DYNAMICS GRID     *
*      .                    CORRESPONDING TO THE PLOTTING GRID     *
*      .                    POINT, I.  BLANKS ARE LEFT IN THOSE    *
*      .                    POSITIONS OF THE ARRAY FOR WHICH NO    *
*      ...                  MODAL DATA IS AVAILABLE.               *
*                                                                  *
*      FORMAT = (10I5). NUMBER OF CARDS IS (NCDI - 1)/10 + 1.      *
*                                                                  *
*      DATA ARE ENTERED BY PROGRAM VIBRAP.                         *
*                                                                  *
********************************************************************
```

ITEM	DATA	DESCRIPTION

AFAM - AUTOMATED FLUTTER ANALYSIS MODULE

I. PREPARATION OF CARD DATA

CARD INPUT DATA MUST ALWAYS BE ENTERED FOR THE MAIN PROGRAM. REMAINING DATA WILL DEPEND UPON THE OPTIONS THE USER IS EXERCISING.

A. GENERAL DESCRIPTIONS AND LIMITATIONS

```
1. ... FA00           IDENTIFIES THE BEGINNING OF THE CARD
   .                  INPUT DATA TO THE AUTOMATED FLUTTER
   .                  ANALYSIS MODULE (AFAM).  MUST BE
   ...                ENTERED AS SHOWN.
```

USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE AND REFERENCE PAGE NUMBER APPEARING IN THE TABLE OF CONTENTS AT THE END OF EACH EXECUTION. REMAINING COLUMNS (FIVE TO SEVENTY TWO) MAY BE USED FOR ANY DESCRIPTIVE INFORMATION THE USER WISHES TO INCLUDE.

```
----------
0000000001
1234567890
----------
FA00|
----------
```

FORMAT = (1A4). NUMBER OF CARDS IS 1.

DATA ARE ENTERED BY SUBROUTINE AFAM AND SUBROUTINE LDB WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE PROPER HEADING FOR THE TABLE OF CONTENTS.

ENTER (SIXTEEN WORDS PER CARD) FOR THE FOLLOWING ITEM FOR L=1,....,16.

```
2. ... TSHF(L)        SUBTITLE CONSISTING OF ONE CARD.
```

WILL BE LISTED AFTER THE MAIN TITLE AT THE TOP OF EACH PAGE OF THE LISTED RESULTS AND WILL BE USED TO DEFINE

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*     THE TYPE OF FLUTTER ANALYSIS BEING PERFORMED.  THE              *
*     SUBTITLE IS INCREASED TO EIGHTEEN WORDS WITHIN THE              *
*     PROGRAMS WHERE THE LAST TWO WORDS ARE USED TO IDENTIFY          *
*     THE PROGRAM FROM WHICH RESULTS ARE LISTED.                      *
*                                                                     *
*     FORMAT = (16A4).  NUMBER OF CARDS IS 1.                         *
*                                                                     *
*     DATA ARE ENTERED BY THE SUBROUTINE AFAM.                        *
*                                                                     *
***********************************************************************
*                                                                     *
*  3. ... KLUEF(1) = 0  FIXED VARIABLE, EQUAL TO ZERO.                *
*                                                                     *
*     FORMAT = (1I4).  NUMBER OF CARDS IS 1.                          *
*                                                                     *
*     DATA ARE ENTERED BY THE SUBROUTINE AFAM THROUGH THE             *
*     SUBROUTINE CLUES.                                               *
*                                                                     *
***********************************************************************
*                                                                     *
*  4. ... LC( 1) =-1      P-K FLUTTER ANALYSIS AND/OR                 *
*     .         =-1      FOR FLUTTER REDESIGN.                        *
*     .         = 0      PRESSURE CALCULATIONS ONLY.                  *
*     .         = 1      K FLUTTER ANALYSIS.                          *
*     .         = 2      DIVERGENCE ANALYSIS.                         *
*     .                                                               *
*     .   LC( 2)         NUMBER OF VIBRATION MODES TO BE USED         *
*     .                  IN THE ANALYSIS.                             *
*     .                  MAXIMUM NUMBER IS TWENTY.                    *
*     .                                                               *
*     .   LC( 3)         NUMBER OF LIFTING SURFACES.                  *
*     .                  FOR MACH BOX AND ASSUMED PRESSURE            *
*     .                  FUNCTION THE MAXIMUM NUMBER IS FIVE.         *
*     .                  FOR DOUBLET LATTICE THE MAXIMUM              *
*     .                  NUMBER IS THIRTY.                            *
*     .                  IN THE DOUBLET LATTICE ANALYSIS.             *
*     .                  THEY AERODYNAMICALLY INTERACT,               *
*     .                  WHEREAS IN OTHER ANALYSES THEY DO            *
*     .                  NOT. FOR FLUTTER REDESIGN, LC(3) =           *
*     .                  1.                                           *
*     .                                                               *
*     .   LC( 4)         NUMBER OF REDUCED VELOCITIES FOR             *
*     .                  WHICH AERODYNAMIC PRESSURES AND/OR           *
*     .                  FORCES ARE TO BE COMPUTED.                   *
*     .                  FORCES WILL BE INTERPOLATED WHEN             *
*     .                  LC(1) = 1 AND LC(13) = 1.                    *
*     .                  IF LC(1) = -1 LET LC(4) = 6.                 *
*     .                  IF LC(1) = 0 OR 1 THEN LC(4) MUST BE         *
*     .                  EQUAL TO OR LESS THAN THIRTY.                *
*     .                  IF LC(1) = 2 LET LC(4) = 1.                  *
*     .                                                               *
*     .   LC( 5)         NUMBER OF AIR DENSITIES FOR WHICH            *
```

```
ITEM      DATA           DESCRIPTION
----      ----           -----------

*    .                   THE FLUTTER OR DIVERGENCE ANALYSES          *
*    .                   WILL BE RUN.                                *
*    .                   MAXIMUM NUMBER IS TEN.                      *
*    .                   IF LC(1) = 0 LET LC(5) = 0.                 *
*    .                                                               *
*    .    LC( 6) = 1     LIST AERODYNAMIC FORCES, COMPUTED           *
*    .                   AND INTERPOLATED, AT THE TESTED             *
*    .                   REDUCED FREQUENCIES OF THE                  *
*    .                   GENERALIZED AERODYNAMIC FORCE               *
*    .                   INTERPOLATION.                              *
*    .           = 0     NO DISPLAY.                                 *
*    .                                                               *
*    .    LC( 7) = 1     LIST CALCULATED PRESSURES.                  *
*    .           = 0     NO DISPLAY.                                 *
*    .                                                               *
*    .    LC( 8) = 1     LIST LIFT AND MOMENT COEFFICIENTS.          *
*    .           = 0     NO DISPLAY.                                 *
*    .                                                               *
*    .    LC( 9) = 1     FREQUENCY INDEPENDENT ADDITIONS TO          *
*    .                   THE AERODYNAMIC MATRIX QBAR ARE TO          *
*    .                   BE READ AS DATA.                            *
*    .           = 0     NO SUCH ADDITIONS ARE TO BE MADE.           *
*    .                                                               *
*    .    LC(10) = 1     LIST THE FULL SET OF INTERPOLATED           *
*    .                   GENERALIZED AERODYNAMIC FORCES WHEN         *
*    .                   USING K FLUTTER METHOD.                     *
*    .           = 0     NO DISPLAY.                                 *
*    .                                                               *
*    .    LC(11)         INDEX OF MODAL FREQUENCY TO BE USED         *
*    .                   AS A NORMALIZATION FACTOR IN THE            *
*    .                   FLUTTER DETERMINANT.  ANY NON-ZERO          *
*    .                   MODAL FREQUENCY IS ACCEPTABLE.              *
*    .                   SUGGEST LC(11) = 1.                         *
*    .                                                               *
*    .    LC(12) = 1     FLUTTER DETERMINANT IS FORMULATED AS        *
*    .                   THE PRODUCT OF THE INVERSE OF THE           *
*    .                   GENERALIZED STIFFNESS MATRIX AND THE        *
*    .                   SUM OF THE GENERALIZED MASS AND             *
*    .                   AERODYNAMIC FORCE MATRICES.                 *
*    .           = 0     DETERMINANT IS FORMULATED AS THE            *
*    .                   PRODUCT OF THE INVERSE OF THE SUM OF        *
*    .                   THE GENERALIZED MASS AND AERODYNAMIC        *
*    .                   MATRICES, AND THE STIFFNESS MATRIX.         *
*    .                   IF LC(1) DOES NOT EQUAL 1 OR 2 LET          *
*    .                   LC(12) = 0.                                 *
*    .                   NOTE THAT IF ZERO-FREQUENCY MODES           *
*    .                   ARE PRESENT IN THE ANALYSIS LC(12)          *
*    .                   MUST BE ZERO.                               *
*    .                                                               *
*    .    LC(13) = 1     GENERALIZED AERODYNAMIC FORCE               *
*    .                   INTERPOLATION IS USED.                      *
*    .           = 0     AERODYNAMIC FORCES ARE DIRECTLY             *
```

```
 ITEM      DATA            DESCRIPTION
 ----      ----            -----------

*     .                    COMPUTED AT EACH REDUCED FREQUENCY.     *
*     .                    IF LC(1) =-1 LET LC(13) = 1.            *
*     .                    IF LC(1) = 0 OR 2 LET LC(13) = 0.       *
*     .                    IF LC(1) = 1 LET LC(13) = 0 OR 1.       *
*     .                                                            *
*     .    LC(14) = 1      CALCOMP PLOTS OF THE FLUTTER            *
*     .                    SOLUTION ARE TO BE PRODUCED.            *
*     .           = 0      NO PLOTS.                               *
*     .                                                            *
*     .    LC(15) = 1      VELOCITY SCALE IN THE FLUTTER           *
*     .                    SOLUTION PLOTS IS IN TRUE AIRSPEED.     *
*     .           = 0      SCALE IS IN EQUIVALENT AIRSPEED.        *
*     .                                                            *
*     .    LC(16) = 0      NO STRUCTURAL DAMPING IS ADDED TO       *
*     .                    THE COMPLEX STIFFNESS MATRIX.           *
*     .           =-1      DIFFERENT DAMPING VALUES ARE ADDED      *
*     .                    TO THE COMPLEX STIFFNESS MATRIX FOR     *
*     .                    EACH MODE.                              *
*     .           = 1      THE SAME VALUE OF DAMPING IS ADDED      *
*     .                    FOR ALL MODES.                          *
*     .                                                            *
*     .    LC(17) = 1      DISPLAY THE NUMBER OF ITERATIONS        *
*     .                    REQUIRED TO OBTAIN EACH ROOT IN THE     *
*     .                    P-K FLUTTER ANALYSIS.                   *
*     .           = 0      NO DISPLAY.                             *
*     .                    IF LC(1) DOES NOT EQUAL -1 LET          *
*     .                    LC(17) = 0.                             *
*     .                                                            *
*     .    LC(18) = 1      FOR THE THIRD AND HIGHER VELOCITIES     *
*     .                    IN THE P-K FLUTTER ANALYSIS, THE        *
*     .                    INITIAL ESTIMATE OF EACH ROOT IS        *
*     .                    OBTAINED BY EXTRAPOLATING FROM THE      *
*     .                    ROOT VALUES AT THE PREVIOUS TWO         *
*     .                    VELOCITIES.                             *
*     .           = 0      THE VALUE OF THE ROOT AT THE            *
*     .                    PREVIOUS VELOCITY IS USED AS THE        *
*     .                    ROOT ESTIMATE.                          *
*     .                    IF LC(1) DOES NOT EQUAL -1 LET          *
*     .                    LC(18) = 0.                             *
*     .                                                            *
*     .    LC(19) = 1      ORDER THE ROOTS AFTER SOLUTION BY       *
*     .                    THE P-K FLUTTER ANALYSIS.               *
*     .           = 0      NO ORDERING.                            *
*     .                    IF LC(1) DOES NOT EQUAL -1 LET          *
*     .                    LC(19) = 0.                             *
*     .                                                            *
*     .    LC(20) = 1      DISPLAY THE ROOT ITERATIONS IN THE      *
*     .                    P-K FLUTTER ANALYSIS (LC(1) = -1) OR    *
*     .                    DISPLAY INTERMEDIATE RESULTS OF THE     *
*     .                    K FLUTTER ANALYSIS (LC(1) = 1).         *
*     .           = 0      NO DISPLAY.                             *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*       .  LC(21)           TYPE OF AERODYNAMICS PROGRAM USED.          *
*       .          = 1      SUBSONIC DOUBLET LATTICE (RODDEN).          *
*       .          = 2      SUPERSONIC MACH BOX.                        *
*       .          = 3      SUBSONIC ASSUMED-PRESSURE-FUNCTION          *
*       .                   (KERNEL).                                   *
*       .                                                               *
*       .  LC(22) = 0       (ALL AERODYNAMIC THEORIES) COMPUTE          *
*       .                   AIC ARRAYS AND PLACE ON AN OUTPUT           *
*       .                   DATA SET TO SAVE FOR FUTURE AS WELL         *
*       .                   AS PRESENT USE.                             *
*       .          = 1      AIC ARRAYS EXIST ON AN INPUT DATA           *
*       .                   SET AND DO NOT NEED TO BE                   *
*       .                   RECOMPUTED.                                 *
*       .          =-1      MACH BOX PROGRAM IS BEING USED AND          *
*       .                   PRESSURES ARE TO BE COMPUTED                *
*       .                   DIRECTLY.  NO AIC WILL BE GENERATED.        *
*       .                                                               *
*       .  LC(23) = 1       DISPLAY MODAL INPUT DATA.                   *
*       .          = 0      NO DISPLAY.                                 *
*       .                                                               *
*       .  LC(24) = 1       DISPLAY INTERPOLATED MODAL DATA.            *
*       .          = 0      NO DISPLAY.                                 *
*       .                                                               *
*       .  LC(25)           NUMBER OF MODAL ELIMINATION CYCLES          *
*       .                   REQUESTED FOR THE FLUTTER ANALYSIS.         *
*       .                   MINIMUM NUMBER IS ZERO.  MAXIMUM            *
*       .                   NUMBER IS TWENTY FIVE.                      *
*       .                                                               *
*       .  LC(26)           NUMBER OF STIFFNESS VARIATION CYCLES        *
*       .                   REQUESTED FOR THE FLUTTER ANALYSIS.         *
*       .                   MINIMUM NUMBER IS ZERO.  MAXIMUM            *
*       .                   NUMBER IS TWENTY.                           *
*       .                                                               *
*       .  LC(27)           INDEX OF THE VIBRATION MODE WHOSE           *
*       .                   STIFFNESS IS TO BE VARIED IN THE            *
*       .                   FLUTTER ANALYSIS.                           *
*       .                   IF LC(26) = 0 LET LC(27) = 0.               *
*       .                                                               *
*       .  LC(28) = 1       DISPLAY EIGENVECTORS                        *
*       .          = 0      NO DISPLAY.                                 *
*       .                   IF LC(1) = 0 OR 2 LET LC(28) = 0.           *
*       .                   IF LC(1) =-1 THE EIGENVECTORS FOR           *
*       .                   THE CRITICAL FLUTTER ROOT IN A              *
*       .                   USER-CHOSEN VELOCITY INTERVAL IS            *
*       .                   DISPLAYED.                                  *
*       .                   IF LC(1) = 1 THE EIGENVECTORS FOR           *
*       .                   ALL ROOTS BETWEEN USER-CHOSEN               *
*       .                   REDUCED VELOCITIES AND REAL                 *
*       .                   FREQUENCIES ARE DISPLAYED.                  *
*       .                                                               *
*       .  LC(29) = 1       DISPLAY PHYSICAL VECTORS                    *
*       .                   CORRESPONDING TO THE DISPLAYED MODAL        *
```

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*      .              EIGENVECTORS.                              *
*      .         = 0  NO DISPLAY.                                *
*      .                                                         *
*      .  LC(30) = 1  DISPLAY FLUTTER DETERMINANT MATRIX         *
*      .              IN K FLUTTER ANALYSIS (SEE LC(12)).        *
*      .         = 0  NO DISPLAY.                                *
*      .              IF LC(1) = -1 OR 0 LET LC(30) = 0.         *
*      .                                                         *
*      .  LC(31) = 1  USER WILL INPUT CHANGES TO THE             *
*      .              GENERALIZED MASSES AND THE MODAL           *
*      .              FREQUENCIES.                               *
*      .         = 0  NO CHANGES.                                *
*      .                                                         *
*      .  LC(32) = 1  USER WILL INPUT REVISIONS TO THE           *
*      .              GENERALIZED STIFFNESS MATRIX.              *
*      .         = 0  NO REVISIONS.                              *
*      .                                                         *
*      .  LC(33) = 1  STEADY STATE ANALYSIS.                     *
*      .         = 0  OSCILLATORY ANALYSIS.                      *
*      .              IF LC(1) = 2, LET LC(33) = 1.              *
*      .                                                         *
*      .  LC(34) = 1  USER WILL INPUT FACTORS TO SCALE THE       *
*      .              COMPUTED AERODYNAMIC FORCES.               *
*      .         = 0  NO FACTORS.                                *
*      .                                                         *
*      .  LC(35) = 1  DISPLAY DOWNWASH IN THE DIAPHRAGM          *
*      .              REGIONS WHEN THE MACH-BOX METHOD IS        *
*      .              USED.                                      *
*      .         = 0  NO DISPLAY.                                *
*      .              IF LC(21) DOES NOT EQUAL 2 OR IF           *
*      .              LC(22) = 1 LET LC(35) = 0.                 *
*      .                                                         *
*      .  LC(36) = 1  COMPUTE EIGENVECTORS AND THE               *
*      .              AERODYNAMIC FORCE GRADIENTS REQUIRED       *
*      .              FOR FLUTTER REDESIGN.                      *
*      .         = 0  DO NOT COMPUTE.                            *
*      .              IF LC(1) DOES NOT EQUAL -1 LET             *
*      .              LC(36) = 0.                                *
*      .                                                         *
*      .  LC(37) = 1  FOR DOUBLET LATTICE PROGRAM, DISPLAY       *
*      .              GEOMETRIC DATA ASSOCIATED WITH BASIC       *
*      .              DOUBLET ELEMENTS.                          *
*      .         = 0  NO DISPLAY.                                *
*      .              IF LC(21) DOES NOT EQUAL 1 LET             *
*      ...            LC(37) = 0.                                *
*                                                                *
*     FORMAT = (10I5).  NUMBER OF CARDS IS 4.                    *
*                                                                *
*     DATA ARE ENTERED BY SUBROUTINE AFAM.                       *
*                                                                *
******************************************************************
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*  5. ... IN = 1            MODAL VIBRATION DATA ARE INPUT ON          *
*      .                    CARDS.                                     *
*      .       = 2          MODAL DATA ARE INPUT ON A TAPE WITH        *
*      .                    THREE SEPARATE FILES FOR THE               *
*      .                    GENERALIZED MASS, MODAL FREQUENCIES,       *
*      .                    AND MODAL DISPLACEMENTS.                   *
*      .       = 3          MODAL DATA CONSISTING OF THE               *
*      .                    FREQUENCIES, GENERALIZED MASSES, AND       *
*      .                    MODAL DISPLACEMENTS ARE STORED IN          *
*      .                    ONE FILE ON UNIT 17 (NOTE THAT IN =        *
*      .                    3 WHEN MODAL DATA ARE GENERATED BY         *
*     ...                   VIBRATION MODULE (AVAM).)                  *
*                                                                      *
*     FORMAT = (1I5). NUMBER OF CARDS 1.                               *
*                                                                      *
*     DATA ARE ENTERED BY SUBROUTINE POOL.                             *
*                                                                      *
************************************************************************
*                                                                      *
*  6. ... LOGIC ITEM          *** NO DATA ***                          *
*                                                                      *
*     IF MODAL VIBRATION DATA ARE ON CARDS (IN = 1) ENTER THE          *
*     FOLLOWING FIVE ITEMS, OTHERWISE (IN DOES NOT EQUAL ONE)          *
*     OMIT THESE FIVE ITEMS.                                           *
*                                                                      *
************************************************************************
*                                                                      *
*  7. ... NC                TOTAL NUMBER OF MODAL DEGREES OF           *
*      .                    FREEDOM USED TO DEFINE A MODE SHAPE        *
*      .                    FOR THE FLUTTER MATH-MODEL.                *
*     ...                    (INCLUDE ALL SURFACES PLUS BODY)          *
*                                                                      *
*     FORMAT = (1I5).  NUMBER OF CARDS IS 1.                           *
*                                                                      *
*     DATA ARE ENTERED BY SUBROUTINE POOL.                             *
*                                                                      *
************************************************************************
*                                                                      *
*                                                                      *
*     1.  MODAL DEFORMATIONS                                           *
*     ----------------------                                           *
*                                                                      *
*     REPEAT THE FOLLOWING ITEM FOR I=1,...,LC(2), AND                 *
*     ENTER (SEVEN VALUES PER CARD) FOR K=1,...,NC                     *
*                                                                      *
*  8. ... QZ(K,I)           MODAL DEFORMATIONS FOR THE I'TH MODE       *
*     ...                   AND K'TH DEGREE OF FREEDOM.                *
*                                                                      *
*     THESE MODES ARE ORDERED SUCH THAT                                *
*                                                                      *
*     DEFORMATIONS ON EACH SURFACE (AND EACH BODY, WHEN USING          *
*     THE DOUBLET LATTICE METHOD) ARE INPUT AS A BLOCK.  THE           *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*     BLOCKS ARE INPUT IN THE SAME ORDER AS THE GEOMETRY DATA   *
*     FOR THE SURFACES (AND BODIES) WILL BE ENTERED.            *
*                                                               *
*     WITHIN A BLOCK, DEFORMATIONS ON THE SURFACE PRECEDE       *
*     THOSE ON ITS CONTROL SURFACE.                             *
*                                                               *
*     FOR A SURFACE, THE POINTS AT WHICH DEFORMATIONS ARE       *
*     SPECIFIED LIE ON SETS OF LINES ORIENTED SPANWISE AND      *
*     SEQUENCED FORWARD TO AFT.  ON EACH SUCH LINE, THE POINTS  *
*     ARE ORDERED INBOARD TO OUTBOARD.  THE DEFORMATIONS MUST   *
*     BE ORDERED CORRESPONDINGLY.                               *
*                                                               *
*     FOR A SURFACE, ELASTIC AXIS REPRESENTATION MAY BE USED    *
*     ALONG A LINE.  AT EACH POINT A DISPLACEMENT AND AN        *
*     ACCOMPANYING PITCH ROTATION ARE INPUT AS CONSECUTIVE      *
*     DEFORMATIONS.                                             *
*                                                               *
*     FOR A BODY, DISPLACEMENTS ALONG A CENTER LINE ARE INPUT,  *
*     FORWARD TO AFT.                                           *
*                                                               *
*     AN ILLUSTRATIVE EXAMPLE SHOWING THE ORDERING FOR A        *
*     SURFACE WITH A CONTROL SURFACE IS SHOWN IN FIGURE 1.      *
*                                                               *
*     FORMAT = (7E10.0). NUMBER OF CARDS IS LC(2) * ((NC-1)/7   *
*     + 1).                                                     *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE POOL.                      *
*                                                               *
*****************************************************************
*                                                               *
*  9. ... NCARD            NUMBER OF DATA CARDS TO FOLLOW       *
*     .                    CONTAINING ALL NON-ZERO ELEMENTS OF  *
*     ...                  THE GENERALIZED MASS MATRIX.         *
*                                                               *
*     FORMAT = (1I5). NUMBER OF CARDS IS 1.                     *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE POOL.                      *
*                                                               *
*****************************************************************
*                                                               *
*     REPEAT THE FOLLOWING ITEM FOR N=1,....,NCARD, AND         *
*     ENTER (THREE GROUPS OF VALUES PER CARD)                   *
*                                                               *
* 10. ... I                ROW INDEX OF GENERALIZED MASS        *
*     .                    MATRIX.                              *
*     .                                                         *
*     .   J                COLUMN INDEX OF GENERALIZED MASS     *
*     .                    MATRIX.                              *
*     .                                                         *
*     .   WW(I,J)          GENERALIZED MASS MATRIX OF EACH      *
*     ...                  NON-ZERO VALUE, LB.                  *
```

```
 ITEM       DATA             DESCRIPTION
 ----       ----             -----------

*     FORMAT = 3(2I5.E10.0).  NUMBER OF CARDS IS NCARD.             *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE POOL.                          *
*                                                                   *
*********************************************************************
*                                                                   *
*     ENTER (SEVEN VALUES PER CARD), AND                            *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....LC(2)                   *
*                                                                   *
* 11. ... OMG(I)            MODAL FREQUENCIES IN PROPER             *
*     ...                   SEQUENCE, HZ.                           *
*                                                                   *
*     FORMAT = (7E10.3).  NUMBER OF CARDS IS (LC(2)-1)/7 + 1.       *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE POOL.                          *
*                                                                   *
*********************************************************************
*                                                                   *
* 12. ... LOGIC ITEM            *** NO DATA ***                     *
*                                                                   *
*     IF MODAL VIBRATION,DATA IS ON CARDS (IN = 1) OMIT THE         *
*     FOLLOWING TWO ITEMS.                                          *
*                                                                   *
*     IF MODAL VIBRATION DATA ARE ON TAPE WITH THREE SEPARATE       *
*     FILES (IN = 2) ENTER THE FOLLOWING TWO ITEMS.                 *
*                                                                   *
*     IF IN = 3 ENTER ITEM 14 ONLY.                                 *
*                                                                   *
*********************************************************************
*                                                                   *
* 13. ... IDMODE            FILE ON DSIO UNIT 12 CONTAINING         *
*     .                     DISPLACEMENTS.                          *
*     .                                                             *
*     .   IDMAS             FILE ON DSIO UNIT 12 CONTAINING         *
*     .                     GENERALIZED MASSES.                     *
*     .                                                             *
*     .   IDOMG             FILE ON DSIO UNIT 12 CONTAINING         *
*     ...                   FREQUENCIES.                            *
*                                                                   *
*     FORMAT = (3I5).  NUMBER OF CARDS IS 1.                        *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE POOL.                          *
*                                                                   *
*********************************************************************
*                                                                   *
*     ENTER (TEN VALUES PER CARD), AND                              *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....LC(2)                   *
*                                                                   *
* 14. ... IFLMD(I)          INDICES OF THE MODES TO BE USED IN      *
*     ...                   THE FLUTTER ANALYSIS.                   *
*                                                                   *
*     KNOWLEDGE OF THE SEQUENCE AND NATURE OF THE MODES             *
```

```
 ITEM       DATA             DESCRIPTION
 ----       ----             -----------

*      COMPUTED IN THE VIBRATION ANALYSIS IS NEEDED TO MAKE AN      *
*      INTELLIGENT SELECTION HERE OF MODES THAT WILL BE             *
*      IMPORTANT TO THE FLUTTER MECHANISM.                          *
*                                                                   *
*      FORMAT = (10I5).  NUMBER OF CARDS IS (LC(2)-1)/10 + 1.       *
*                                                                   *
*      DATA ARE ENTERED BY SUBROUTINE POOL.                         *
*                                                                   *
*********************************************************************
*                                                                   *
* 15. ... BR                REFERENCE SEMICHORD, IN.                *
*      .                                                            *
*      ... FMACH            FREE STREAM MACH NUMBER.                *
*                                                                   *
*      FORMAT = (2E10.0).  NUMBER OF CARDS IS 1.                    *
*                                                                   *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                       *
*                                                                   *
*********************************************************************
*                                                                   *
* 16. ... LOGIC ITEM          *** NO DATA ***                       *
*                                                                   *
*      FOR DIVERGENCE ANALYSIS (L((1) = 2) OMIT ITEMS 17 TO 34.     *
*      AND GO TO ITEM 35, OTHERWISE (LC(1) DOES NOT EQUAL 2)        *
*      CONTINUE BELOW.                                              *
*                                                                   *
*      FOR STEADY STATE PRESSURES (LC(1) = 0 AND LC(33) = 1)        *
*      OMIT ITEMS 17 TO 55, AND GO TO ITEM 56, OTHERWISE FOR        *
*      OSCILLATORY ANALYSIS (LC(33) = 0) CONTINUE BELOW.            *
*                                                                   *
*      FOR P-K FLUTTER ANALYSIS (LC(1) = -1) OMIT THE FOLLOWING     *
*      TWO ITEMS AND GO TO ITEM 19, OTHERWISE (LC(1) DOES NOT       *
*      EQUAL -1) ENTER DATA FOR THE FOLLOWING ITEM.                 *
*                                                                   *
*********************************************************************
*                                                                   *
*      ENTER (SEVEN VALUES PER CARD), AND                           *
*      REPEAT THE FOLLOWING ITEM FOR I=1,...,LC(4)                  *
*                                                                   *
* 17. ... VBO(I)            REDUCED VELOCITIES TO BE USED IN THE    *
*      .                    K-FLUTTER ANALYSIS OR PRESSURE          *
*      ...                  CALCULATIONS.                           *
*                                                                   *
*      FORMAT = (7E10.0). NUMBER OF CARDS IS (LC(4)-1)/7 + 1.       *
*                                                                   *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                       *
*                                                                   *
*********************************************************************
*                                                                   *
* 18. ... LOGIC ITEM          *** NO DATA ***                       *
*                                                                   *
*      FOR PRESSURE CALCULATIONS ONLY (LC(1) = 0) OMIT ITEMS 19     *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*      TO 55 AND GO TO ITEM 56, OTHERWISE (LC(1) DOES NOT EQUAL  *
*      ZERO) CONTINUE BELOW.                                      *
*                                                                 *
*      IF GENERALIZED AERODYNAMIC FORCE INTERPOLATION IS USED     *
*      (LC(13) = 1) OMIT THE FOLLOWING ITEM AND ENTER DATA FOR    *
*      ITEM 20.                                                   *
*                                                                 *
*      IF AERODYNAMIC FORCES ARE DIRECTLY COMPUTED AT EACH        *
*      REDUCED VELOCITY (LC(13) = 0) OMIT THE FOLLOWING TWO       *
*      ITEMS.                                                     *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*      2. P-K FLUTTER ANALYSIS PARAMETERS                         *
*      ----------------------------------                         *
*                                                                 *
* 19. ... NV              NUMBER OF VELOCITIES AT WHICH THE       *
*      .                  ANALYSIS IS TO BE PERFORMED             *
*      .                  INITIALLY.                              *
*      .                  MAXIMUM VALUE IS TWENTY FIVE.           *
*      .                                                          *
*      .   V1             LOWEST VELOCITY AT WHICH THE            *
*      .                  ANALYSIS IS TO BE PERFORMED, KNOTS.     *
*      .                                                          *
*      .   DV             INTERVAL BETWEEN INITIAL VELOCITIES     *
*      .                  AT WHICH THE ANALYSIS IS PERFORMED,     *
*     ...                 KNOTS.                                  *
*                                                                 *
*      V1 AND DV ARE IN TRUE AIRSPEED.  THE ANALYSIS IS           *
*      INITIALLY DONE AT A SET OF NV VELOCITIES GIVEN BY V(I) =   *
*      V(I-1) + DV, WHERE V(1) = V1.  THE PROGRAM DETECTS         *
*      UNDULATIONS IN THE DAMPING AND FREQUENCY VARIATIONS WITH   *
*      VELOCITY AND, UNDER CERTAIN CONDITIONS, CALCULATES         *
*      ADDITIONAL SOLUTIONS AT VELOCITIES GIVEN BY V(J) =         *
*      V(J-1) + DV/5. IT IS SUGGESTED THAT V1 BE CHOSEN TO BE     *
*      AT LEAST 200 AND THAT DV BE LESS THAN 250.                 *
*                                                                 *
*      FORMAT = (1I5,2E10.0).  NUMBER OF CARDS IS 1.              *
*                                                                 *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                     *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*      3.  GENERALIZED AERODYNAMIC FORCE INTERPOLATION            *
*      -----------------------------------------------            *
*          PARAMETERS                                             *
*          ----------                                             *
*                                                                 *
* 20. ... TOL             TOLERANCE USED FOR TESTING THE          *
*      .                  GOODNESS OF FIT OF THIS                 *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*     .                   INTERPOLATION.                              *
*     .                                                               *
*     .   RVBO(I)         SIX (I= 1,6) REFERENCE VALUES OF            *
*     .                   REDUCED VELOCITY FROM WHICH THE             *
*     .                   BASIS (OR KNOWN POINTS OF) THE              *
*     ...                 INTERPOLATION IS DERIVED.                   *
*                                                                     *
*     A NOMINAL VALUE OF TOL = 0.02 IS RECOMMENDED.  IF               *
*     AIC-MATRICES ARE BEING CALCULATED AND SAVED ON THE              *
*     PRESENT SUBMITTAL, HOWEVER, A VALUE OF TOL = 10.E-6 IS          *
*     SUGGESTED TO ASSURE THAT AIC'S FOR ALL SIX RVBO(I)'S ARE        *
*     SAVED.  WHEN SUBSEQUENT RE-ANALYSES ARE RUN WITH                *
*     POSSIBLE NEW MODES, THE TOLERANCE IS RESET TO 0.02.  THE        *
*     RVBO(I)'S SHOULD SPAN THE ENTIRE RANGE OF REDUCED               *
*     VELOCITIES REQUIRED FOR THE FLUTTER ANALYSIS.  FOR THE          *
*     K-FLUTTER ANALYSIS, THIS IMPLIES THAT RVBO(1) IS LESS           *
*     THAN OR EQUAL TO VBO(1) AND RVBO(6) IS GREATER THAN OR          *
*     EQUAL TO VBO(LC(4)).   FOR THE P-K FLUTTER ANALYSIS, THE        *
*     FOLLOWING APPROXIMATIONS SHOULD BE USED.                        *
*     RVBO(1) IS LESS THAN OR EQUAL TO 1.69* 12 * VMIN /(BR *         *
*     WMAX)                                                           *
*     RVBO(6) IS GREATER THAN OR EQUAL TO 1.69* 12 * VMAX /(BR        *
*     * WMIN)                                                         *
*     WHERE,                                                          *
*     VMIN = V1, KNOTS                                                *
*     VMAX = V1 + (NV-1)*DV, KNOTS                                    *
*     WMAX AND WMIN ARE THE MAXIMUM AND MINIMUM MODAL                 *
*     FREQUENCIES IN RAD/SEC                                          *
*     BR IS THE REFERENCE SEMICHORD IN INCHES.                        *
*                                                                     *
*     FORMAT = (7E10.0).  NUMBER OF CARDS IS 1.                       *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                          *
***********************************************************************
*                                                                     *
* 21. ... LOGIC ITEM          *** NO DATA ***                         *
*                                                                     *
*     IF NO CHANGES ARE INCLUDED IN THE GENERALIZED MASSES AND        *
*     MODAL FREQUENCIES (LC(31) = 0) OMIT THE FOLLOWING FOUR          *
*     ITEMS AND GO TO ITEM 26, OTHERWISE (LC(31) = 1) ENTER           *
*     DATA FOR THE FOLLOWING ITEMS.                                   *
*                                                                     *
***********************************************************************
*                                                                     *
* 22. ... MADD            NUMBER OF DATA CARDS TO FOLLOW              *
*     .                   CONTAINING CHANGES TO THE                   *
*     .                   GENERALIZED MASS MATRIX.                    *
*     .                                                               *
*     .   IADD            NUMBER OF DATA CARDS WITH CHANGES TO        *
*     .                   THE MODAL FREQUENCIES.                      *
*     .                                                               *
*     .   MSYM = 0        IF CHANGES TO MASS MATRIX ARE               *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*      .                    SYMMETRIC (WW(I,J) = WW(J,I)).            *
*      .         = 1        IF CHANGES TO MASS MATRIX ARE NOT         *
*      ...                  SYMMETRIC.                                *
*                                                                     *
*      FORMAT = (3I5).  NUMBER OF CARDS IS 1.                         *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                         *
***********************************************************************
*                                                                     *
*      REPEAT THE FOLLOWING ITEM FOR K=1,...,MADD                     *
*                                                                     *
* 23.  ... I                ROW INDEX OF THE ALTERED ELEMENT OF       *
*      .                    THE GENERALIZED MASS.                     *
*      .                                                              *
*      .   J                COLUMN INDEX OF THE ALTERED ELEMENT       *
*      .                    OF THE GENERALIZED MASS.                  *
*      .                                                              *
*      .   WW(I,J)          NEW VALUE OF THE ALTERED ELEMENTS OF      *
*      .                    THE GENERALIZED MASS.                     *
*      .                    IF MSYM = 0, SPECIFY ONLY THE UPPER       *
*      ...                  TRIANGULAR ELEMENTS.                      *
*                                                                     *
*      FORMAT = (2I5,1E10.0).  NUMBER OF CARDS IS MADD.               *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                         *
***********************************************************************
*                                                                     *
* 24.  ... LOGIC ITEM           *** NO DATA ***                       *
*                                                                     *
*      IF NUMBER OF DATA CARDS WITH CHANGES TO THE MODAL              *
*      FREQUENCIES ARE ZERO (IADO = 0) OMIT THE FOLLOWING ITEM        *
*      AND GO TO ITEM 26, OTHERWISE (IADO DOES NOT EQUAL ZERO)        *
*      ENTER DATA FOR THE FOLLOWING ITEM.                             *
*                                                                     *
***********************************************************************
*                                                                     *
*      REPEAT THE FOLLOWING ITEM FOR K=1,...,IADO                     *
*                                                                     *
* 25.  ... I                INDEX OF THE ALTERED MODAL                *
*      .                    FREQUENCIES.                              *
*      .                                                              *
*      .   OMG((I)          NEW VALUE OF THE ALTERED MODAL            *
*      ...                  FREQUENCIES, HZ.                          *
*                                                                     *
*      FORMAT = (1I5,1E10.0).  NUMBER OF CARDS IS IADO.               *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                         *
*                                                                     *
***********************************************************************
*                                                                     *
* 26.  ... LOGIC ITEM           *** NO DATA ***                       *
```

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*     IF NO STRUCTURAL DAMPING IS ADDED TO THE STIFFNESS          *
*     MATRIX (LC(16) = 0) OMIT THE FOLLOWING THREE ITEMS AND      *
*     GO TO ITEM 30. OTHERWISE (LC(16) = -1 OR 1) CONTINUE        *
*     BELOW.                                                      *
*                                                                 *
*     IF DIFFERENT STRUCTURAL DAMPING VALUES ARE ADDED TO THE     *
*     COMPLEX STIFFNESS MATRIX IN VARIOUS MODES (LC(16) = -1)     *
*     OMIT THE FOLLOWING ITEM AND GO TO TO ITEM 28. OTHERWISE     *
*     (LC(16) = 1) CONTINUE BELOW.                                *
*                                                                 *
*     IF THE SAME VALUE OF DAMPING IS ADDED FOR ALL MODES         *
*     (LC(16) = 1) ENTER DATA FOR THE FOLLOWING ITEM AND OMIT     *
*     ITEMS 28 AND 29.                                            *
*                                                                 *
*******************************************************************
*                                                                 *
* 27. ... GDD              HYSTERETIC STRUCTURAL DAMPING TO BE    *
*     .                    APPLIED TO ALL MODES.  THE DIAGONAL    *
*     .                    OF THE STIFFNESS MATRIX WILL BE        *
*     ...                  SCALED BY (1 + i * GDD).               *
*                                                                 *
*     FORMAT = (1E10.0).  NUMBER OF CARDS IS 1.                   *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                      *
*                                                                 *
*******************************************************************
*                                                                 *
* 28. ... NCD              NUMBER OF INDIVIDUAL MODES FOR WHICH   *
*     .                    STRUCTURAL DAMPING WILL BE             *
*     ...                  SPECIFIED.                             *
*                                                                 *
*     FORMAT = (1I5).  NUMBER OF CARDS IS 1.                      *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                      *
*                                                                 *
*******************************************************************
*                                                                 *
*     REPEAT THE FOLLOWING ITEM FOR K=1,...,NCD                   *
*                                                                 *
* 29. ... I                MODE INDEX OF HYSTERETIC DAMPING.      *
*     .                                                           *
*     .   GDP(I)           VALUE OF HYSTERETIC DAMPING APPLIED    *
*     ...                  TO A MODE.                             *
*                                                                 *
*     FORMAT = (1I5,1E10.0).  NUMBER OF CARDS IS NCD.             *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                      *
*                                                                 *
*******************************************************************
*                                                                 *
*     THE FOLLOWING ITEM PROVIDES PRINT-PLOT PARAMETERS FOR       *
*     DISPLAYING FLUTTER SOLUTIONS - DAMPING AND FREQUENCY AS     *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*     FUNCTIONS OF VELOCITY.                                          *
*                                                                     *
* 30. ... GMAX           MAXIMUM VALUE OF DAMPING SCALE.              *
*       .                                                             *
*       .   GMIN         MINIMUM VALUE OF DAMPING SCALE.              *
*       .                                                             *
*       .   VMAX         MAXIMUM VALUE OF VELOCITY SCALE.             *
*       .                KNOTS.                                       *
*       .                                                             *
*       .   FMAX         MAXIMUM VALUE OF FREQUENCY SCALE,            *
*       ...              HZ.                                          *
*                                                                     *
*     FORMAT = (4E10.0).  NUMBER OF CARDS IS 1.                       *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                          *
*                                                                     *
***********************************************************************
*                                                                     *
* 31. ... LOGIC ITEM          *** NO DATA ***                         *
*                                                                     *
*     IF CALCOMP PLOTS OF THE FLUTTER SOLUTION ARE TO BE              *
*     PROVIDED (LC(14) = 1) ENTER DATA FOR THE FOLLOWING THREE        *
*     ITEMS, OTHERWISE (LC(14) = 0) OMIT THESE ITEMS.                 *
*                                                                     *
***********************************************************************
*                                                                     *
*     REPEAT THE FOLLOWING ITEM TWICE.                                *
*                                                                     *
* 32. ... TITLE          TITLES FOR CALCOMP PLOTS OF FLUTTER          *
*       ...              SOLUTIONS.                                   *
*                                                                     *
*     FORMAT = (18A4) FOR IBM COMPUTER.  NUMBER OF CARDS IS 2.        *
*     FORMAT = (7A10, 1A2) FOR CDC COMPUTER.  NUMBER OF CARDS         *
*     IS 2.                                                           *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                          *
*                                                                     *
***********************************************************************
*                                                                     *
*     THE FOLLOWING ITEM PROVIDES CALCOMP PARAMETERS FOR              *
*     FLUTTER PLOTS.                                                  *
*                                                                     *
* 33. ... LSD = 1        HORIZONTAL AXIS IS VELOCITY.                 *
*       .                 DAMPING PLOT IS ABOVE FREQUENCY             *
*       .                PLOT.                                        *
*       .       = 2      VERTICAL SCALE IS VELOCITY.  DAMPING         *
*       .                AND FREQUENCY PLOTS ARE ORIENTED             *
*       .                ALONG THE LONG DIRECTION.                    *
*       .       = 3      HORIZONTAL AXIS IS VELOCITY.                 *
*       .                 DAMPING AND FREQUENCY PLOTS ARE             *
*       .                SIDE BY SIDE.                                *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*     .   DUB              MAXIMUM VALUE OF HYSTERETIC DAMPING      *
*     .                    SCALE.                                    *
*     .                                                              *
*     .   FUB              MAXIMUM VALUE OF FREQUENCY SCALE,        *
*     .                    HZ.                                       *
*     .                                                              *
*     .   VUB              MAXIMUM VALUE OF VELOCITY SCALE,         *
*     .                    KNOTS, EAS.                               *
*     .                                                              *
*     ... DLB              MINIMUM VALUE OF DAMPING SCALE,.         *
*                                                                    *
*     FORMAT = (1I5, 4E10.0).  NUMBER OF CARDS IS 1.                 *
*                                                                    *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                         *
*                                                                    *
**********************************************************************
*                                                                    *
*     THE FOLLOWING ITEM PROVIDES CALCOMP SCALING FACTORS.           *
*                                                                    *
* 34. ... DSCALE           UNITS PER INCH OF PLOT FOR DAMPING.      *
*     .                                                              *
*     .   FSCALE           UNITS PER INCH OF PLOT FOR                *
*     .                    FREQUENCY, HZ/IN.                         *
*     .                                                              *
*     .   VSCALE           UNITS PER INCH OF PLOT FOR VELOCITY,     *
*     ...                  KNOTS/IN.                                 *
*                                                                    *
*     THE UPPER AND LOWER BOUNDS (DUB, FUB, VUB, AND DLB)            *
*     SHOULD BE MULTIPLES OF THE RESPECTIVE SCALING FACTORS.         *
*      TESTS ARE MADE TO ENSURE THE PLOT AXES WILL NOT OVERLAP       *
*     OR EXCEED PAGE SIZE.  IF THEY DO, THE PLOT OPTION IS           *
*     CANCELLED.  THE PAGE SIZE TESTS ARE.                           *
*                                                                    *
*     IF LSD = 1,  (FUB / FSCALE) + ((DUB-DLB) / DSCALE)             *
*                  SHOULD BE EQUAL TO OR LESS THAN 8.5.              *
*                                                                    *
*     IF LSD = 2,  (VUB /VSCALE)  SHOULD BE EQUAL TO OR LESS         *
*                  THAN 8.5.                                         *
*                                                                    *
*     IF LSD = 3,  ((DUB-DLB) / DSCALE)  SHOULD BE EQUAL TO OR       *
*                  LESS THAN 8.5 AND  (FUB / FSCALE)                 *
*                  SHOULD BE EQUAL TO OR LESS THAN 8.5.              *
*                                                                    *
*     FORMAT = (3E10.0).  NUMBER OF CARDS IS 1.                      *
*                                                                    *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                         *
*                                                                    *
**********************************************************************
*                                                                    *
*     ENTER (SEVEN VALUES PER CARD), AND                             *
*     REPEAT THE FOLLOWING ITEM FOR I=1,...,LC(5).                   *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

* 35. ... RHOR(I)         DENSITY RATIOS FOR FLUTTER OR               *
*     ...                 DIVERGENCE ANALYSES.                        *
*                                                                     *
*     REFERENCED TO SEA LEVEL AIR DENSITY. MAXIMUM NUMBER IS          *
*     TEN.                                                            *
*                                                                     *
*     FORMAT = (7E10.0). NUMBER OF CARDS IS (LC(5)-1)/7 + 1.          *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                          *
*                                                                     *
***********************************************************************
*                                                                     *
***********************************************************************
*                                                                     *
* 36. ... LOGIC ITEM          *** NO DATA ***                         *
*                                                                     *
*     IF USER INPUTS FACTORS TO SCALE THE COMPUTED AERODYNAMIC        *
*     FORCES (LC(34) = 1) ENTER DATA FOR THE FOLLOWING FIVE           *
*     ITEMS, OTHERWISE (LC(34) = 0) OMIT THESE ITEMS.                 *
*                                                                     *
***********************************************************************
*                                                                     *
* 37. ... NQWT            NUMBER OF LIFTING SURFACES FOR WHICH        *
*     .                   THE GENERALIZED AERODYNAMIC FORCES          *
*     .                   DUE TO SPECIFIED MODES WILL BE              *
*     .                   ELIMINATED.                                 *
*     .                                                               *
*     .   NQE             NUMBER OF LIFTING SURFACES FOR WHICH        *
*     .                   THE GENERALIZED AERODYNAMIC FORCES          *
*     .                   WILL BE MULTIPLIED BY A FACTOR NOT          *
*     ...                 EQUAL TO ONE.                               *
*                                                                     *
*     FORMAT = (2I5).  NUMBER OF CARDS IS 1.                          *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                          *
*                                                                     *
***********************************************************************
*                                                                     *
* 38. ... LOGIC ITEM          *** NO DATA ***                         *
*                                                                     *
*     IF GENERALIZED AERODYNAMIC FORCES ARE TO BE ELIMINATED          *
*     FOR A NUMBER OF LIFTING SURFACES (NQWT GREATER THAN             *
*     ZERO) ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE (NQWT        *
*     = 0) OMIT THIS ITEM.                                            *
*                                                                     *
***********************************************************************
*                                                                     *
*     REPEAT THE FOLLOWING ITEM FOR I=1,...,NQWT                      *
*     ENTER (TEN VALUES PER CARD)                                     *
*                                                                     *
* 39. ... ISF             SURFACE INDEX.                              *
```

```
 ITEM      DATA             DESCRIPTION
 ----      ----             -----------

*      .   NISF             NUMBER OF MODES FOR WHICH THE          *
*      .                    GENERALIZED AERODYNAMIC FORCE OF       *
*      .                    SURFACE ISF WILL BE ELIMINATED.        *
*      .                                                           *
*      .   NQA(J)           J=1,....,NISF, MODAL INDICES FOR       *
*      ...                  GENERALIZED AERODYNAMIC ELIMINATION.   *
*                                                                  *
*      FOR THE ISF SURFACE, QBAR( K, NQA(J) ), QBAR( NQA(I), K     *
*      ), AND QBAR( NQA(J), NQA(J) ) ARE TO BE ELIMINATED.         *
*                                                                  *
*      FORMAT = (10I5).  NUMBER OF CARDS IS (NISF+1)/10 + 1.       *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                      *
*                                                                  *
********************************************************************
*                                                                  *
* 40. ... LOGIC ITEM           *** NO DATA ***                     *
*                                                                  *
*      IF GENERALIZED AERODYNAMIC FORCES ARE TO BE MULTIPLES OF    *
*      A FACTOR OTHER THAN ONE FOR A NUMBER OF LIFTING SURFACES    *
*      (NQE GREATER THAN ZERO) ENTER DATA FOR THE FOLLOWING        *
*      ITEM, OTHERWISE (NQE = 0) OMIT THIS ITEM.                   *
*                                                                  *
********************************************************************
*                                                                  *
*      REPEAT THE FOLLOWING ITEM FOR J=1,....,NQE                  *
*                                                                  *
* 41. ... I                 SURFACE INDEX.                         *
*      .                                                           *
*      .   QWT(I)           WEIGHTING FACTOR FOR THE GENERALIZED   *
*      .                    AERODYNAMIC FORCE FOR THE I'TH         *
*      ...                  SURFACE.                               *
*                                                                  *
*      FORMAT = (1I5, 1E10.0).  NUMBER OF CARDS IS 1.              *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                      *
*                                                                  *
********************************************************************
*                                                                  *
* 42. ... LOGIC ITEM           *** NO DATA ***                     *
*                                                                  *
*      IF FREQUENCY-INDEPENDENT ADDITIONS TO THE AERODYNAMIC       *
*      MATRIX ARE TO BE INCLUDED, (LC(9) = 1), ENTER DATA FOR      *
*      THE FOLLOWING TWO ITEMS, OTHERWISE (LC(9) = 0) OMIT         *
*      THESE ITEMS.                                                *
*                                                                  *
********************************************************************
*                                                                  *
* 43. ... NADDF             NUMBER OF CARDS TO FOLLOW ON WHICH     *
*      .                    ADDITIONS TO THE FLUTTER               *
*      .                    DETERMINANT'S AERODYNAMIC MATRIX,      *
*      .                    QBAR, WILL BE INPUT.                   *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*      .   NSYM = 1         SPECIFY ALL NON-ZERO ADDITIONS.            *
*      .        = 0         ADDITIONS ARE SYMMETRIC.  SUPPLY           *
*      ...                  ONLY THE UPPER TRIANGULAR ARRAY.           *
*                                                                      *
*      FORMAT = (2I5).  NUMBER OF CARDS IS 1.                          *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                          *
*                                                                      *
************************************************************************
*                                                                      *
*      REPEAT THE FOLLOWING ITEM FOR K = 1,...., NADDF                 *
*                                                                      *
* 44. ... I                 ROW INDEX OF ADDITIONS TO THE              *
*      .                    AERODYNAMIC MATRIX.                        *
*      .                                                               *
*      .   J                COLUMN INDEX OF ADDITIONS TO THE           *
*      .                    AERODYNAMIC MATRIX.                        *
*      .                                                               *
*      .   DETAD(I,J)       VALUE OF THE ADDITIONS TO THE              *
*      .                    FLUTTER DETERMINANT'S AERODYNAMIC          *
*      .                    MATRIX.                                    *
*      .                    SPECIFY BOTH A REAL AND IMAGINARY          *
*      .                    PART OF THE VALUE.  THESE ADDITIONS        *
*      .                    ARE FREQUENCY INDEPENDENT ADDITIONS        *
*      .                    TO THE AERODYNAMIC MATRIX.  QBAR +         *
*      .                    DETAD(REAL) / K**2 + IMAG *                *
*      .                    DETAD(IMAG)/ K, WHERE K IS THE             *
*      ...                  REDUCED FREQUENCY.                         *
*                                                                      *
*      FORMAT = (2I5, 2E10.0).  NUMBER OF CARDS IS NADDF.              *
*                                                                      *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                          *
*                                                                      *
************************************************************************
*                                                                      *
* 45. ... LOGIC ITEM           *** NO DATA ***                         *
*                                                                      *
*      IF REVISIONS TO THE GENERALIZED STIFFNESS ARE TO BE             *
*      INCLUDED (LC(32) = 1) ENTER DATA FOR THE FOLLOWING TWO          *
*      ITEMS, OTHERWISE (LC(32) = 0) OMIT THESE ITEMS.                 *
*                                                                      *
************************************************************************
*                                                                      *
* 46. ... NADDS             NUMBER OF DATA CARDS TO FOLLOW             *
*      .                    CONTAINING CHANGES TO THE STIFFNESS        *
*      .                    MATRIX.                                    *
*      .                                                               *
*      .   NSYM = 0         IF CHANGES ARE SYMMETRIC (B(I,J) =         *
*      .                    B(J,I).                                    *
*      ...      = 1         IF CHANGES ARE NOT SYMMETRIC.              *
*                                                                      *
*      FORMAT = (2I5).  NUMBER OF CARDS IS 1.                          *
```

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                            *
*                                                                       *
*************************************************************************
*                                                                       *
*     REPEAT THE FOLLOWING ITEM FOR K = 1,...., NADDS                   *
*                                                                       *
* 47. ... I                 ROW INDEX OF NEW STIFFNESS MATRIX.          *
*     .                                                                 *
*     .    J                COLUMN INDEX OF NEW STIFFNESS               *
*     .                     MATRIX.                                     *
*     .                                                                 *
*     .    B(I,J)           NEW VALUES OF THE COMPLEX STIFFNESS         *
*     ...                   MATRIX.                                     *
*                                                                       *
*     NOTE THAT THE VALUES MAY BE COMPLEX NUMBERS.  IF NSYM =           *
*     0, ONLY THE UPPER TRIANGULAR ELEMENTS NEED BE SPECIFIED.          *
*                                                                       *
*     FORMAT = (2I5, 2E10.0).  NUMBER OF CARDS IS NADDS.                *
*                                                                       *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                            *
*                                                                       *
*************************************************************************
*                                                                       *
* 48. ... LOGIC ITEM          *** NO DATA ***                           *
*                                                                       *
*     IF STIFFNESS VARIATION IS TO BE INCLUDED IN THE FLUTTER           *
*     ANALYSIS (LC(26) GREATER THAN ZERO) ENTER DATA FOR THE            *
*     FOLLOWING ITEM, OTHERWISE (LC(26) = 0) OMIT THIS ITEM.            *
*                                                                       *
*************************************************************************
*                                                                       *
*     4.  STIFFNESS VARIATIONS                                          *
*     ------------------------                                          *
*                                                                       *
*     AFTER THE INITIAL FLUTTER OR DIVERGENCE ANALYSIS IS               *
*     PERFORMED, ADDITIONAL LC(26) ANALYSES - UP TO A MAXIMUM           *
*     OF TWENTY - ARE RUN WITH THE STIFFNESS OF MODE LC(27)             *
*     VARIED BY RATIOING ITS MODAL FREQUENCY VARIOUS SELECTED           *
*     AMOUNTS.                                                          *
*                                                                       *
*     ENTER (SEVEN VALUES PER CARD), AND                                *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....,LC(26)                     *
*                                                                       *
* 49. ... RATOM(I)          DESIRED RATIOS OF MODAL FREQUENCIES.        *
*                                                                       *
*     FORMAT = (7E10.0).  NUMBER OF CARDS IS (LC(26)-1)/7 + 1.          *
*                                                                       *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                            *
*                                                                       *
*************************************************************************
*                                                                       *
* 50. ... LOGIC ITEM          *** NO DATA ***                           *
```

```
ITEM      DATA              DESCRIPTION
----      ----              -----------

*      IF MODAL ELIMINATION IS TO BE INCLUDED IN THE FLUTTER         *
*      ANALYSIS (LC(25) GREATER THAN ZERO), ENTER DATA FOR THE       *
*      FOLLOWING ITEM, OTHERWISE (LC(25) = 0) OMIT THIS ITEM.        *
*                                                                    *
**********************************************************************
*                                                                    *
*      5.  MODAL ELIMINATION DATA                                    *
*      --------------------------                                    *
*                                                                    *
*      A FLUTTER OR DIVERGENCE ANALYSIS IS PERFORMED USING THE       *
*      MODES SELECTED IN ITEM 14, AFTER WHICH ADDITIONAL LC(25)      *
*      ANALYSES - UP TO A MAXIMUM OF TWENTY FIVE - ARE RUN WITH      *
*      DIFFERENT SELECTED COMBINATIONS OF MODES DELETED FROM         *
*      THE ANALYSIS AT EACH RE-RUN.                                  *
*                                                                    *
*      REPEAT THE FOLLOWING ITEM FOR I=1,...,LC(25).                 *
*      ENTER (TEN VALUES PER CARD)                                   *
*                                                                    *
* 51.  ... NOTIR             NUMBER OF MODES TO BE ELIMINATED.       *
*      .                                                             *
*      .   NINZ(J,I)         J=1,....,NOTIR, INDICES OF THE NODES    *
*      ...                   TO BE ELIMINATED.                       *
*                                                                    *
*      FORMAT = (10I5).   NUMBER OF CARDS IS NOTIR/10 + 1.           *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                        *
*                                                                    *
**********************************************************************
*                                                                    *
* 52.  ... LOGIC ITEM           *** NO DATA ***                      *
*                                                                    *
*      IF EIGENVECTORS ARE NOT TO BE DISPLAYED (LC(28) = 0)          *
*      OMIT THE FOLLOWING THREE ITEMS.                               *
*                                                                    *
**********************************************************************
*                                                                    *
* 53.  ... VA                LOWER BOUND OF THE RANGE OVER WHICH     *
*      .                     EIGENVECTORS ARE TO BE CALCULATED.      *
*      .                                                             *
*      .   VB                UPPER BOUND OF THE RANGE OVER WHICH     *
*      ...                   EIGENVECTORS ARE TO BE CALCULATED.      *
*                                                                    *
*      IF LC(1) = -1, THE RANGE IS VELOCITY, KNOTS.                  *
*      IF LC(1) =  1, THE RANGE IS REDUCED VELOCITY, V /(B *         *
*      OMEGA).                                                       *
*                                                                    *
*      FORMAT = (2E10.0).  NUMBER OF CARDS IS 1.                     *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE FLINFO.                        *
*                                                                    *
**********************************************************************
```

```
 ITEM      DATA            DESCRIPTION
 ----      ----            -----------

* 54. ... LOGIC ITEM          *** NO DATA ***                       *
*                                                                   *
*     IF P-K FLUTTER ANALYSIS IS TO BE PERFORMED (LC(1) = -1)       *
*     OMIT DATA FOR THE FOLLOWING ITEM, AND GO TO ITEM 56,          *
*     OTHERWISE (LC(1) = 1) ENTER DATA FOR THE FOLLOWING ITEM.      *
*                                                                   *
*********************************************************************
*                                                                   *
* 55. ... FLC               LOWER BOUND OF THE FREQUENCY RANGE      *
*       .                   OVER WHICH EIGENVECTORS ARE TO BE       *
*       .                   DISPLAYED, HZ.                          *
*       .                                                           *
*       .  FHI              UPPER BOUND OF THE FREQUENCY RANGE      *
*       .                   OVER WHICH EIGENVECTORS ARE TO BE       *
*       ...                 DISPLAYED, HZ.                          *
*                                                                   *
*     FORMAT = (2E10.0).  NUMBER OF CARDS IS 1.                     *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE FLINFO.                        *
*                                                                   *
*********************************************************************
*                                                                   *
* 56. ... LOGIC ITEM          *** NO DATA ***                       *
*                                                                   *
*     THE DATA IN THE FOLLOWING PAGES ARE DIVIDED INTO THREE        *
*     GROUPS ASSOCIATED WITH THE THREE AERODYNAMIC THEORIES.        *
*      THE PARTICULAR ITEMS TO BE EXECUTED FOR EACH                 *
*     AERODYNAMIC THEORY ARE SUMMARIZED BELOW.                      *
*                                                                   *
*********************************************************************
*                                                                   *
*     LC(21) =1, DOUBLET LATTICE PROCEDURE (RODDEN)                 *
*     ---------------------------------------------                 *
*                                                                   *
*     ENTER DATA FOR ITEMS 1R TO 33R.                               *
*                                                                   *
*     LC(21) = 2, MACH BOX PROCEDURE                                *
*     ------------------------------                                *
*                                                                   *
*     ENTER DATA FOR ITEMS 1M TO 27M.                               *
*                                                                   *
*     LC(21) = 3, ASSUMED-PRESSURE-FUNCTION PROCEDURE (KERNEL)      *
*     --------------------------------------------------------      *
*                                                                   *
*     ENTER DATA FOR ITEMS 1K TO 28K.                               *
*                                                                   *
*********************************************************************
```

```
 ITEM      DATA        DESCRIPTION
 ----      ----        -----------

*****************************************************************
*                                                               *
*     8.  SUBSONIC AERODYNAMICS USING DOUBLET                   *
*     ---------------------------------------                   *
*         LATTICE PROCEDURE (RODDEN)                            *
*         --------------------------                            *
*                                                               *
*****************************************************************
*                                                               *
*   1R ... LOGIC ITEM      *** NO DATA ***                      *
*                                                               *
*     IF THE DOUBLET LATTICE PROCEDURE IS TO BE USED (LC(21) =  *
*     1) ENTER DATA FOR ITEMS TWO TO THIRTY THREE, OTHERWISE    *
*     (LC(21) DOES NOT EQUAL ONE) OMIT THESE ITEMS.             *
*                                                               *
*****************************************************************
*                                                               *
*   2R ... FL          REFERENCE CHORD TO BE USED IN COMPUTING  *
*      .               THE TOTAL SURFACE AERODYNAMIC FORCE      *
*      .               COEFFICIENTS, IN.                        *
*      .                                                        *
*      .   ACAP        REFERENCE AREA TO BE USED IN COMPUTING   *
*      .               THE TOTAL SURFACE AERODYNAMIC FORCE      *
*      ...             COEFFICIENTS, IN**2.                     *
*                                                               *
*     USUALLY THE MEAN AERODYNAMIC CHORD AND THE TOTAL SURFACE  *
*     AREA ARE USED, BUT OTHER NON-ZERO VALUES ARE ACCEPTABLE.  *
*                                                               *
*     FORMAT = (2E10.0).  NUMBER OF CARDS IS 1.                 *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE RODDEN.                    *
*                                                               *
*****************************************************************
*                                                               *
*   3R ... NDELT = 1   AERODYNAMICS ARE SYMMETRICAL ABOUT Y =   *
*      .               0.                                       *
*      .         =-1   AERODYNAMICS ARE ANTISYMMETRICAL ABOUT   *
*      .               Y = 0.                                   *
*      .         = 0   NO SYMMETRY ABOUT Y = 0 (SINGLE          *
*      .               SURFACE).                                *
*      .                                                        *
*      .   NP          TOTAL NUMBER OF PANELS ON ALL LIFTING    *
*      .               SURFACES AND ALL OPTIONAL INTERACTING    *
*      .               BODIES. MAXIMUM NUMBER IS 50.            *
*      .               EACH SURFACE IS DIVIDED INTO MAJOR       *
*      .               TRAPEZOIDAL SUBDIVISIONS CALLED PANELS   *
*      .               BASED UPON GEOMETRICAL DISCONTINUITIES.  *
*      .                THIS IS ILLUSTRATED IN FIGURES 2 AND    *
*      .               3. THE PARALLEL EDGES ARE PARALLEL TO    *
*      .               THE FREE STREAM.                         *
*      .                                                        *
*      .   NB          NUMBER OF BODIES THAT AERODYNAMICALLY    *
```

```
 ITEM      DATA         DESCRIPTION
 ----      ----         -----------

*      .               INTERACT WITH THE SURFACE(S). MAXIMUM       *
*      .               NUMBER IS 20.                               *
*      .               IF THE VIBRATION ANALYSIS (IN FASTOP)       *
*      .               IS EMPLOYED, NB IS CURRENTLY RESTRICTED     *
*      .               TO ZERO.                                    *
*      .                                                           *
*      .    NCORE      SIZE OF THE PROBLEM BEING SOLVED = N *      *
*      .               M.                                          *
*      .               THE VARIABLE N IS THE NUMBER OF             *
*      .               ELEMENTS ON THE LIFTING SURFACE AND THE     *
*      .               BODIES, N = SUM FROM 1 TO NP OF ((NS-1)     *
*      .               * (NC-1)), WHERE NS AND NC ARE ENTERED      *
*      .               AS DATA IN ITEM 6R BELOW. THE VARIABLE      *
*      .               M IS THE NUMBER OF MODES, LC(2). NOTE       *
*      .               THAT MAXIMUM VALUE OF N IS 400.             *
*      .                                                           *
*      .    N3 = 1     DISPLAY PRESSURE INFLUENCE                  *
*      .               COEFFICIENTS.                               *
*      .       = 0     NO DISPLAY.                                 *
*      .                                                           *
*      .    N4 = 1     DISPLAY INFLUENCE COEFFICIENTS RELATING     *
*      .               DOWNWASH ON LIFTING SURFACES TO BODY        *
*      .               ELEMENT PRESSURES.                          *
*      .       = 0     NO DISPLAY.                                 *
*      .                                                           *
*      .    N7 = 1     CALCULATE PRESSURES AND GENERALIZED         *
*      .               AERODYNAMIC FORCES. (NORMAL SUMBITTAL).     *
*      .       = 0     CEASE COMPUTATIONS AFTER THE INFLUENCE      *
*      ...             COEFFICIENTS ARE DETERMINED.                *
*                                                                  *
*      FORMAT = (7I5).  NUMBER OF CARDS IS 1.                      *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE RODDEN                       *
*                                                                  *
********************************************************************
*                                                                  *
*      REPEAT THE FOLLOWING FIVE ITEMS FOR                         *
*      EACH PANEL FOR I=1,...,NP                                   *
*                                                                  *
*      THE PROPER SEQUENCE IS.                                     *
*                                                                  *
*      1. VERTICAL PANELS ON THE SYMMETRY PLANE, Y=0 SUCH AS       *
*         A CONVENTIONAL VERTICAL TAIL.                            *
*      2. PANELS ON THE OTHER SURFACES, SUCH AS THE WING.          *
*      3. BODY INTERFERENCE PANELS.                                *
*                                                                  *
*      THE FOLLOWING COORDINATES ARE IN THE GLOBAL (AIRCRAFT)      *
*      SYSTEM AND INDICATE THE POSITION OF THE ORIGIN OF THE       *
*      LOCAL COORDINATE SYSTEM FOR EACH PANEL.                     *
*                                                                  *
*   4R ... X0(I)       X REFERENCE COORDINATE OF I'TH PANEL.       *
*      .               IN.                                         *
```

```
 ITEM      DATA        DESCRIPTION
 ----      ----        -----------

*      .   YO(I)       Y REFERENCE COORDINATE OF I'TH PANEL.          *
*      .               IN.                                            *
*      .                                                              *
*      .   ZO(I)       Z REFERENCE COORDINATE OF I'TH PANEL.          *
*      .               IN.                                            *
*      .                                                              *
*      .   GGMAS(I)    DIHEDRAL FOR THE I'TH PANEL, DEG.              *
*      ...             (ZERO FOR BODY INTERFERENCE PANELS)            *
*                                                                     *
*      MODAL INTERPOLATION IS PERFORMED BEFORE THESE REFERENCE        *
*      VALUES ARE USED TO TRANSLATE AND ROTATE THE PANELS.            *
*       CONSEQUENTLY, THE STANDARD PRACTICE IS TO ASSIGN EACH         *
*      PANEL ON A PARTICULAR SURFACE THE SAME REFERENCE VALUES.       *
*       SEE FIGURE 2. ALSO, EACH INTERFERENCE PANEL ASSOCIATED        *
*      WITH A PARTICULAR BODY IS ASSIGNED THE SAME REFERENCE          *
*      VALUES.                                                        *
*                                                                     *
*      FORMAT = (4F10.0).  NUMBER OF CARDS IS 1 FOR THE I'TH          *
*      PANEL.                                                         *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE PART1.                          *
*                                                                     *
***********************************************************************
*                                                                     *
*  5R ... X1           X EDGE COORDINATE OF THE I'TH PANEL,           *
*      .               IN.                                            *
*      .                                                              *
*      .   X2          X EDGE COORDINATE OF THE I'TH PANEL,           *
*      .               IN.                                            *
*      .                                                              *
*      .   X3          X EDGE COORDINATE OF THE I'TH PANEL,           *
*      .               IN.                                            *
*      .                                                              *
*      .   X4          X EDGE COORDINATE OF THE I'TH PANEL,           *
*      .               IN.                                            *
*      .                                                              *
*      .   Y1          Y EDGE COORDINATE OF THE I'TH PANEL.           *
*      .               IN.                                            *
*      .                                                              *
*      .   Y2          Y EDGE COORDINATE OF THE I'TH PANEL.           *
*      ...             IN.                                            *
*                                                                     *
*      THE COORDINATES (X1, Y1) AND (X2, Y1) ARE THE LEADING          *
*      AND TRAILING INBOARD CORNERS.  THE COORDINATES (X3, Y2)        *
*      AND (X4, Y2) ARE THE LEADING AND TRAILING OUTBOARD             *
*      CORNERS.  SEE FIGURES 3 AND 4. THESE COORDINATES ARE           *
*      SPECIFIED IN THE LOCAL AXIS SYSTEM OF EACH SURFACE.            *
*                                                                     *
*      FORMAT = (6F10).  NUMBER OF CARDS IS 1 FOR THE I'TH            *
*      PANEL.                                                         *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE PART1.                          *
```

```
ITEM      DATA         DESCRIPTION
----      ----         -----------

*******************************************************************
*                                                                 *
*  6R ... Z1           VERTICAL COORDINATE OF THE INBOARD EDGE    *
*      .               OF I'TH PANEL, IN.                         *
*      .                                                          *
*      .  Z2           VERTICAL COORDINATE OF THE OUTBOARD        *
*      .               EDGE OF I'TH PANEL, IN.                    *
*      .                                                          *
*      .  NS           NUMBER OF ELEMENT BOUNDARIES IN THE        *
*      .               SPANWISE DIRECTION. MAXIMUM NUMBER IS      *
*      .               FIFTY. (NS = 2 FOR EACH BODY               *
*      .               INTERFERENCE PANEL)                        *
*      .                                                          *
*      .  NC           NUMBER OF ELEMENT BOUNDARIES IN THE        *
*      .               CHORDWISE DIRECTION. MAXIMUM NUMBER IS     *
*      .               FIFTY.                                     *
*      .                                                          *
*      ... COEFF       ENTERED AS ZERO.                           *
*                                                                 *
*      THE PANEL IS DIVIDED INTO A NUMBER OF SMALLER              *
*      TRAPEZOIDS, CALLED ELEMENTS, BY LINES OF CONSTANT          *
*      PERCENT PANEL CHORD AND OF CONSTANT PERCENT PANEL SPAN.    *
*       SEE FIGURES 3 AND 4.                                      *
*                                                                 *
*      FORMAT = (2F10, 1X, 2I3, 3X, 1F10).  NUMBER OF CARDS IS    *
*      1 FOR THE I'TH PANEL.                                      *
*                                                                 *
*      DATA ARE ENTERED BY SUBROUTINE PART1.                      *
*                                                                 *
*******************************************************************
*                                                                 *
*      ENTER (SIX VALUES PER CARD), AND                           *
*      REPEAT THE FOLLOWING ITEM FOR J=1,...,NC                   *
*                                                                 *
*  7R ... TH(J)        CHORDWISE ELEMENT BOUNDARIES FOR THE       *
*      .               I'TH PANEL IN FRACTION OF CHORD.           *
*      ...             NORMALLY TH(1) = 0.0 AND TH(NC) = 1.0.     *
*                                                                 *
*      FORMAT = (6F10).  NUMBER OF CARDS IS (NC-1)/6 + 1 FOR      *
*      THE I'TH PANEL.                                            *
*                                                                 *
*      DATA ARE ENTERED BY SUBROUTINE PART1.                      *
*                                                                 *
*******************************************************************
*                                                                 *
*      ENTER (SIX VALUES PER CARD), AND                           *
*      REPEAT THE FOLLOWING ITEM FOR J=1,...,NS                   *
*                                                                 *
*  8R ... TAU(J)       SPANWISE ELEMENT BOUNDARIES FOR THE        *
*      .               PANEL IN FRACTION OF SPAN.                 *
*      .               NORMALLY TAU(1) = 0.0 AND TAU(NS) =        *
*      ...             1.0.                                       *
```

```
*     FORMAT = (6F10).  NUMBER OF CARDS IS (NS-1)/6 + 1 FOR      *
*     THE I'TH PANEL.                                            *
*                                                                *
*     DATA ARE ENTERED BY SUBROUTINE PART1.                      *
*                                                                *
******************************************************************
*                                                                *
*  9R ... LOGIC ITEM      *** NO DATA ***                        *
*                                                                *
*     IF THERE ARE BODIES THAT AERODYNAMICALLY INTERACT WITH     *
*     THE SURFACES (NB GREATER THAN ZERO) ENTER DATA FOR THE     *
*     FOLLOWING FOUR ITEMS, OTHERWISE (NB = 0) OMIT THESE        *
*     ITEMS.                                                     *
*                                                                *
******************************************************************
*                                                                *
*     A BODY HAS EITHER VERTICAL OR LATERAL VIBRATIONS.  TO      *
*     MODEL A PHYSICAL BODY HAVING BOTH DEGREES OF FREEDOM,      *
*     TWO BODIES MUST BE INPUT.  ALL VERTICALLY VIBRATING        *
*     BODIES MUST BE INPUT BEFORE LATERALLY VIBRATING BODIES.    *
*                                                                *
*     REPEAT THE FOLLOWING FOUR ITEMS FOR                        *
*     EACH BODY FOR I=1,...,NB                                   *
*                                                                *
* 10R ... XBO(I)      X GLOBAL REFERENCE COORDINATE FOR THE      *
*     .               I'TH BODY, IN.                             *
*     .                                                          *
*     .   YBO(I)      Y GLOBAL REFERENCE COORDINATE FOR THE      *
*     .               I'TH BODY, IN.                             *
*     .                                                          *
*     .   ZBO(I)      Z GLOBAL REFERENCE COORDINATE FOR THE      *
*     ...             I'TH BODY, IN.                             *
*                                                                *
*     SEE FIGURE 2. THESE DATA SHOULD AGREE WITH ITEM 4R FOR     *
*     THE ASSOCIATED BODY INTERFERENCE PANELS.                   *
*                                                                *
*     FORMAT = (3F10).  NUMBER OF CARDS IS 1 FOR THE I'TH        *
*     BODY.                                                      *
*                                                                *
*     DATA ARE ENTERED BY SUBROUTINE PART1.                      *
*                                                                *
******************************************************************
*                                                                *
* 11R ... ZSC         LOCAL VERTICAL COORDINATE OF THE I'TH      *
*     .               BODY AXIS, IN.                             *
*     .                                                          *
*     .   YSC         LOCAL LATERAL COORDINATE OF THE I'TH       *
*     .               BODY AXIS, IN.                             *
*     .                                                          *
*     .   NF          THE BODY IS DIVIDED ALONG ITS AXIS INTO    *
*     .               A NUMBER OF ELEMENTS EQUAL TO (NF - 1).    *
```

```
 ITEM      DATA        DESCRIPTION
 ----      ----        -----------

*       .   NZ = 1      BODY IS VIBRATING VERTICALLY.                   *
*       .      = 0      BODY IS NOT VIBRATING VERTICALLY.               *
*       .                                                               *
*       .   NY = 1      BODY IS VIBRATING LATERALLY.                    *
*       .      = 0      BODY IS NOT VIBRATING LATERALLY.                *
*       .                                                               *
*       .               NOTE THAT NZ MUST NOT EQUAL NY.                 *
*       .                                                               *
*       .   COEFF       ENTERED AS ZERO.                                *
*       .                                                               *
*       .   MRK(I,1)    INDEX OF THE FIRST PANEL ELEMENT ON THE         *
*       .               INTERFERENCE PANELS ASSOCIATED WITH THE         *
*       .               I'TH BODY.                                      *
*       .                                                               *
*       .   MRK(I,2)    INDEX OF THE LAST PANEL ELEMENT ON THE          *
*       .               INTERFERENCE PANELS ASSOCIATED WITH THE         *
*       ...             I'TH BODY.                                      *
*                                                                       *
*       FORMAT = (2F10, 1X, 3I2, 3X,1F10, 2I3).  NUMBER OF CARDS        *
*       IS 1 FOR THE I'TH BODY.                                         *
*                                                                       *
*       DATA ARE ENTERED BY SUBROUTINE PART1.                           *
*                                                                       *
*************************************************************************
*                                                                       *
*       ENTER (SIX VALUES PER CARD), AND                                *
*       REPEAT THE FOLLOWING ITEM FOR J=1,....,NF                       *
*                                                                       *
* 12R   ... F(J)          STREAMWISE (X) COORDINATES OF THE             *
*       .                 DIVISIONS OF THE I'TH BODY, STARTING          *
*       .                 WITH BODY NOSE AND PROCEDING AFT, IN.         *
*       ...               (IN LOCAL COORDINATES)                        *
*                                                                       *
*       FORMAT = (6F10).  NUMBER OF CARDS IS 1 FOR THE I'TH             *
*       BODY.                                                           *
*                                                                       *
*       DATA ARE ENTERED BY SUBROUTINE PART1.                           *
*                                                                       *
*************************************************************************
*                                                                       *
*       ENTER (SIX VALUES PER CARD), AND                                *
*       REPEAT THE FOLLOWING ITEM FOR J=1,....,NF                       *
*                                                                       *
* 13R   ... RAD(J)        RADII OF THE I'TH BODY ELEMENTS AT THE        *
*       ...               END POINTS OF DIVISION, IN.                   *
*                                                                       *
*       THE J'TH ELEMENT OF THE BODY IS, THUS, A FRUSTUM OF A           *
*       RIGHT CONE HAVING BASE RADII OF RAD(J) AND RAD(J+1).            *
*                                                                       *
*       FORMAT = (6F10).  NUMBER OF CARDS IS 1 FOR THE I'TH             *
*       BODY.                                                           *
```

```
ITEM      DATA         DESCRIPTION
----      ----         -----------

*     DATA ARE ENTERED BY SUBROUTINE PART1.                          *
*                                                                    *
**********************************************************************
*                                                                    *
* 14R ... NSTRIP        NUMBER OF CHORDWISE STRIPS OF PANEL          *
*      .                ELEMENTS ON ALL PANELS.                      *
*      .                WHEN LC(8) = 1, LIFT AND MOMENT              *
*      .                COEFFICIENTS ARE PRINTED FOR THESE           *
*      .                STRIPS.  WHEN LC(8) = 0, THE USER MAY        *
*      .                SET NSTRIP =1, THUS REDUCING THE NUMBER      *
*      .                CF DATA CARDS NEEDED IN THE FOLLOWING        *
*      .                ITEM TO ONE.  DO NOT SET NSTRIP = 0.         *
*      .                                                             *
*      .  NPR1 = 1      PRINT PRESSURES IN ROUTINE QUAS OR           *
*      .                FUTSOL.  USE FOR DEBUGGING ONLY.             *
*      .       = 0      NO PRINT.                                    *
*      .                                                             *
*      .  JSPECS = 1    ANTISYMMETRICAL AERODYNAMICS ABOUT Z =       *
*      .                0. (BIPLANE OR 'JET' EFFECT).                *
*      .         =-1    SYMMETRICAL AERODYNAMICS ABOUT Z = 0.        *
*      .                (GROUND EFFECT).                             *
*      .         = 0    NO SYMMETRY PLANE Z = 0.                     *
*      .                                                             *
*      .  NSV           NUMBER OF STRIPS ON ALL VERTICAL PANELS      *
*      .                LYING ON THE SYMMETRY PLANE, Y = 0.          *
*      .                                                             *
*      .  NBV           NUMBER OF ELEMENTS ON ALL VERTICAL           *
*      .                PANELS ON THE PLANE Y = 0.                   *
*      .                                                             *
*      .  NYAW          = 0, IF NDELT = 1.                           *
*      .                = 1, IF NDELT = -1.                          *
*      ...              = 0 OR 1, IF NDELT = 0.                      *
*                                                                    *
*      FORMAT = (6I5).  NUMBER OF CARDS IS 1.                        *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE RODDEN.                        *
*                                                                    *
**********************************************************************
*                                                                    *
*      ENTER (SIX VALUES PER CARD), AND                              *
*      REPEAT THE FOLLOWING ITEM FOR J=1,....NSTRIP                  *
*                                                                    *
*      IF COEFFICIENTS ARE NOT REQUIRED (NSTRIP = 1) ENTER           *
*      BLANK CARD.                                                   *
*                                                                    *
* 15R ... LIM(J,1)      INDEX OF FIRST ELEMENT ON EACH               *
*      .                CHORDWISE STRIP.                             *
*      .                                                             *
*      .   LIM(J,2)     INDEX OF LAST ELEMENT ON EACH CHORDWISE      *
*      .                STRIP.                                       *
*      .                                                             *
*      .                WHEN LC(8) = 1, LIFT AND MOMENT              *
```

```
 ITEM     DATA        DESCRIPTION
 ----     ----        -----------

*      .               COEFFICIENTS FOR EACH STRIP ARE                *
*      .               CALCULATED BY APPROPRIATE INTEGRATIONS         *
*      .               CHORDWISE FROM ELEMENT LIM(J,1) TO             *
*      .               LIM(J,2).                                      *
*      .                                                              *
*      ... LIM(J,3)    ENTERED AS ZERO.                               *
*                                                                     *
*      SEE FIGURE 5.                                                  *
*                                                                     *
*      FORMAT = ( 6 * (1X, 3I3)).  NUMBER OF CARDS IS                 *
*      (NSTRIP-1)/6 + 1.                                              *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE RODDEN.                         *
*                                                                     *
***********************************************************************
*                                                                     *
*      REPEAT THE FOLLOWING FOURTEEN ITEMS                            *
*      FOR EACH SURFACE FOR IS=1,...,LC(3)                            *
*                                                                     *
*      1.  PRIMARY SURFACE DATA ASSOCIATED WITH                       *
*      ----------------------------------------                       *
*          MODAL INTERPOLATION                                        *
*          -------------------                                        *
*                                                                     *
* 16R ... KSURF = T   THIS SURFACE HAS ONE OR MORE CONTROL            *
*      .              SURFACES WITH FORWARD HINGE LINES               *
*      .        = F   THIS SURFACE HAS NO CONTROL SURFACES.           *
*      .              WHEN A CONTROL SURFACE IS PRESENT,              *
*      .              MODAL INTERPOLATION IS DONE SEPARATELY          *
*      .              OVER THE AREA AFT OF THE CONTROL                *
*      .              SURFACE LEADING EDGE. CONSEQUENTLY,             *
*      .              MODES ARE DISCONTINUOUS CHORDWISE AT            *
*      .              THE LEADING EDGE AND SPANWISE AT THE            *
*      .              CONTROL SURFACE EDGES.                          *
*      .                                                              *
*      .   NBCXS      NUMBER OF ELEMENTS (DOUBLET BOXES) IN           *
*      .              THIS SURFACE INCLUDING CONTROL                  *
*      .              SURFACES.                                       *
*      .                                                              *
*      .   NCS        NUMBER OF CONTROL SURFACES ON PRIMARY           *
*      .              SURFACE.                                        *
*      ...            MAXIMUM NUMBER IS FIVE.                         *
*                                                                     *
*      FORMAT = (1L5, 2I5).  NUMBER OF CARDS IS 1.                    *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE MIDI.                           *
*                                                                     *
***********************************************************************
*                                                                     *
* 17R ... NLINES      NUMBER OF LINES ON THIS SURFACE ALONG           *
*      .              WHICH MODAL DATA ARE INPUT.                     *
*      .              MAXIMUM NUMBER IS TWENTY.                       *
```

```
ITEM      DATA          DESCRIPTION
----      ----          -----------

*     .                 IF NELAXS = 1 (SEE VARIABLE BELOW) LET      *
*     .                 NLINES = 1. ( SEE FIGURES 6, 7 )            *
*     .                                                             *
*     .    NELAXS = 1   TRANSLATION AND PITCH ROTATION ARE          *
*     .                 PRESCRIBED AT EACH INPUT POINT.             *
*     .           = 0   ONLY TRANSLATION IS PRESCRIBED.             *
*     .                                                             *
*     .    NICH         CONTROL WORD OPTION FOR THE TYPE OF         *
*     .                 EXTRAPOLATION DONE IN THE CHORDWISE         *
*     .                 DIRECTION, IN INTERPOLATING MODAL DATA      *
*     .                 TO THE AERODYNAMICS GRID.                   *
*     .    NICH = 0     LINEAR.                                     *
*     .         = 1     QUADRATIC.                                  *
*     .         = 2     CUBIC.                                      *
*     .                                                             *
*     .    NISP         CONTROL WORD OPTION FOR THE TYPE OF         *
*     .                 EXTRAPOLATION DONE IN THE SPANWISE          *
*     .                  DIRECTION, IN INTERPOLATING MODAL DATA     *
*     .                 TO THE AERODYNAMICS GRID.                   *
*     .    NISP = 0     LINEAR.                                     *
*     .         = 1     QUADRATIC.                                  *
*     ...       = 2     CUBIC.                                      *
*                                                                   *
*     FORMAT = (4I5).  NUMBER OF CARDS IS 1.                        *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE MODAL.                         *
*                                                                   *
*********************************************************************
*                                                                   *
*     MODAL DATA ARE PRESCRIBED, STARTING WITH THE MOST             *
*     FORWARD, MOST INBOARD LINE AND PROCEEDING OUTBOARD AND        *
*     AFT.                                                          *
*                                                                   *
*     REPEAT THE FOLLOWING TWO ITEMS FOR I=1,....NLINES             *
*                                                                   *
* 18R ... NGP(I)        NUMBER OF POINTS ON THE I'TH LINE OF        *
*     .                 PRIMARY SURFACE AT WHICH THE MODAL DATA     *
*     .                 ARE SPECIFIED.                              *
*     .                 MAXIMUM NUMBER IS TWELVE.                   *
*     .                                                             *
*     .   XTERM1(I)     X COORDINATE OF THE INBOARD TERMINUS OF     *
*     .                 THE I'TH LINE FOR THE PRIMARY SURFACE.      *
*     .                 IN. (IN LOCAL, NOT GLOBAL, COORDINATES)     *
*     .                                                             *
*     .   YTERM1(I)     Y COORDINATE OF THE INBOARD TERMINUS OF     *
*     .                 THE I'TH LINE FOR THE PRIMARY SURFACE.      *
*     .                 IN. (IN LOCAL, NOT GLOBAL, COORDINATES)     *
*     .                                                             *
*     .   XTERM2(I)     X COORDINATE OF THE OUTBOARD TERMINUS       *
*     .                 OF THE I'TH LINE FOR THE PRIMARY            *
*     .                 SURFACE, IN. (IN LOCAL, NOT GLOBAL,         *
*     .                 COORDINATES)                                *
```

```
 ITEM      DATA         DESCRIPTION
 ----      ----         -----------

*     .    YTERM2(I)    Y COORDINATE OF THE OUTBOARD TERMINUS     *
*     .                 OF THE I'TH LINE FOR THE PRIMARY          *
*     .                 SURFACE, IN. (IN LOCAL, NOT GLOBAL,       *
*     ...               COORDINATES)                              *
*                                                                 *
*     SEE FIGURE 6.                                               *
*                                                                 *
*     FORMAT = (1I5, 4E10.0).  NUMBER OF CARDS IS 1 FOR THE       *
*     I'TH LINE.                                                  *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE MODAL.                       *
*                                                                 *
*******************************************************************
*                                                                 *
*     ENTER (EIGHT VALUES PER CARD), AND                          *
*     REPEAT THE FOLLOWING ITEM FOR J=1,...,NGP(I).               *
*                                                                 *
* 19R ... YGP(J,I)      SPANWISE COORDINATES OF THE POINTS        *
*     .                 ALONG THE I'TH LINE AT WHICH INPUT        *
*     .                 MODAL DATA ARE GIVEN, IN. (IN LOCAL       *
*     ...               COORDINATES)                              *
*                                                                 *
*     FORMAT = (8E10.0).  NUMBER OF CARDS IS (NGP(I)-1)/8 + 1     *
*     FOR THE I'TH LINE.                                          *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE MODAL.                       *
*                                                                 *
*******************************************************************
*                                                                 *
* 20R ... LOGIC ITEM        *** NO DATA ***                       *
*                                                                 *
*     IF TRANSLATION AND PITCH ROTATION ARE PRESCRIBED AT EACH    *
*     POINT (NELAXS = 1) ENTER DATA FOR THE FOLLOWING ITEM.       *
*     OTHERWISE (NELAXS = 0) OMIT THE FOLLOWING ITEM.             *
*                                                                 *
*******************************************************************
*                                                                 *
* 21R ... DIST          AN ARBITRARY CHORDWISE DISTANCE FOR A     *
*     .                 PRIMARY SURFACE FROM THE GIVEN LINE TO    *
*     .                 A REFERENCE LINE ON WHICH MODAL           *
*     ...               DISPLACEMENTS ARE CALCULATED, IN.         *
*                                                                 *
*     NOTE THAT MODAL DISPLACEMENTS ARE CALCULATED BY H1 = H0     *
*     + A0 * DIST, WHERE H0 AND A0 ARE THE DISPLACEMENT AND       *
*     ROTATION OF A POINT ON A GIVEN LINE AND H1 IS THE           *
*     DISPLACEMENT OF THE CORRESPONDING POINT ON THE NEW LINE.    *
*     THE GIVEN DEFORMATIONS H0 AND A0 ALONG A LINE ARE, THUS,    *
*     CONVERTED TO DISPLACEMENTS H0 AND H1 ALONG TWO PARALLEL     *
*     LINES AND THE MODAL INTERPOLATION IS BASED ON THESE.        *
*                                                                 *
*     FORMAT = (1E10.0).  NUMBER OF CARDS IS 1 FOR EACH           *
*     PRIMARY SURFACE.                                            *
```

```
ITEM      DATA        DESCRIPTION
----      ----        -----------

*     DATA ARE ENTERED BY SUBROUTINE FORM.                              *
*                                                                       *
*************************************************************************
*                                                                       *
* 22R ... LOGIC ITEM      *** NO DATA ***                               *
*                                                                       *
*     IF A PRIMARY SURFACE HAS ONE OR MORE CONTROL SURFACES             *
*     WITH FORWARD HINGE LINES (KSURF= T) ENTER DATA FOR THE            *
*     FOLLOWING ITEM, OTHERWISE (KSURF = F) OMIT THIS ITEM.             *
*                                                                       *
*************************************************************************
*                                                                       *
*     REPEAT THE FOLLOWING ITEM FOR J=1,...,NCS                         *
*     STARTING INBOARD AND PROCEEDING OUTBOARD.                         *
*                                                                       *
* 23R ... X1(J)        X COORDINATE OF THE INBOARD TERMINUS OF          *
*     .                THE J'TH CONTROL SURFACE LEADING EDGE,           *
*     .                IN. (IN LOCAL COORDINATES)                       *
*     .                                                                 *
*     .   Y1(J)        Y COORDINATE OF THE INBOARD TERMINUS OF          *
*     .                THE J'TH CONTROL SURFACE LEADING EDGE.           *
*     .                IN. (IN LOCAL COORDINATES)                       *
*     .                                                                 *
*     .   X2(J)        X COORDINATE OF THE OUTBOARD TERMINUS            *
*     .                OF THE J'TH CONTROL SURFACE LEADING              *
*     .                EDGE, IN. (IN LOCAL COORDINATES)                 *
*     .                                                                 *
*     .   Y2(J)        Y COORDINATE OF THE OUTBOARD TERMINUS            *
*     .                OF THE J'TH CONTROL SURFACE LEADING              *
*     ...              EDGE, IN. (IN LOCAL COORDINATES)                 *
*                                                                       *
*     SEE FIGURE 6.                                                     *
*                                                                       *
*     FORMAT = (4E10.0).  NUMBER OF CARDS IS NCS.                       *
*                                                                       *
*     DATA ARE ENTERED BY SUBROUTINE HELP.                              *
*                                                                       *
*************************************************************************
*                                                                       *
*     2.  CONTROL SURFACE DATA ASSOCIATED WITH                          *
*     ----------------------------------------                          *
*         MODAL INTERPOLATION                                           *
*         -------------------                                           *
*                                                                       *
*************************************************************************
*                                                                       *
* 24R ... LOGIC ITEM      *** NO DATA ***                               *
*                                                                       *
*     IF A PRIMARY SURFACE HAS ONE OR MORE CONTROL SURFACES             *
*     WITH FORWARD HINGE LINES (KSURF= T) ENTER DATA FOR THE            *
*     FOLLOWING FIVE ITEMS OTHERWISE (KSURF = F) OMIT THESE             *
*     ITEMS.                                                            *
```

```
*********************************************************************
*                                                                   *
*     THE FOLLOWING FIVE ITEMS ARE ENTERED ONCE AND ARE             *
*     APPLICABLE TO ALL THE CONTROL SURFACES.  THE VARIABLE         *
*     NLINES IS THE TOTAL FOR ALL CONTROL SURFACES.                 *
*                                                                   *
* 25R ... NLINES      NUMBER OF LINES ON ALL CONTROL SURFACES       *
*     .               ALONG WHICH MODAL DATA ARE INPUT.             *
*     .               MAXIMUM NUMBER IS TWENTY                      *
*     .                                                             *
*     .   NELAXS = 1 TRANSLATION AND PITCH ROTATION ARE             *
*     .               PRESCRIBED AT EACH INPUT POINT.               *
*     .          = 0 ONLY TRANSLATION IS PRESCRIBED.                *
*     .                                                             *
*     .   NICH        CONTROL WORD OPTION FOR THE TYPE OF           *
*     .               EXTRAPOLATICN DONE IN THE CHORDWISE           *
*     .               DIRECTION. IN INTERPOLATING MODAL DATA        *
*     .               TO THE AERODYNAMICS GRID.                     *
*     .   NICH = 0    LINEAR.                                       *
*     .        = 1    QUADRATIC.                                    *
*     .        = 2    CUBIC.                                        *
*     .                                                             *
*     .   NISP        CONTROL WORD OPTION FOR THE TYPE OF           *
*     .               EXTRAPOLATICN DONE IN THE SPANWISE            *
*     .                DIRECTION, IN INTERPOLATING MODAL DATA       *
*     .               TO THE AERODYNAMICS GRID.                     *
*     .   NISP = 0    LINEAR.                                       *
*     .        = 1    QUADRATIC.                                    *
*     ...      = 2    CUBIC.                                        *
*                                                                   *
*     FORMAT = (4I5).  NUMBER OF CARDS IS 1.                        *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE MODAL.                         *
*                                                                   *
*********************************************************************
*                                                                   *
*     MODAL DATA ARE PRESCRIBED, STARTING WITH THE MOST             *
*     FORWARD, MOST INBOARD LINE AND PROCEEDING OUTBOARD AND        *
*     AFT.                                                          *
*                                                                   *
*     REPEAT THE FOLLOWING TWO ITEMS FOR I=1,....,NLINES            *
*                                                                   *
* 26R ... NGP(I)      NUMBER OF POINTS ON THE I'TH LINE OF          *
*     .               CONTROL SURFACE AT WHICH THE MODAL DATA       *
*     .               ARE SPECIFIED.                                *
*     .               MAXIMUM NUMBER IS TWELVE.                     *
*     .                                                             *
*     .   XTERM1(I)   X COORDINATE OF THE INBOARD TERMINUS OF       *
*     .               THE I'TH LINE FOR THE CONTROL SURFACE,        *
*     .               IN. (IN LOCAL COORDINATES)                    *
*     .                                                             *
*     .   YTERM1(I)   Y COORDINATE OF THE INBOARD TERMINUS OF       *
```

```
ITEM      DATA         DESCRIPTION
----      ----         -----------

*         .                 THE I'TH LINE FOR THE CONTROL SURFACE,        *
*         .                 IN. (IN LOCAL COORDINATES)                    *
*         .                                                               *
*         .  XTERM2(I)      X COORDINATE OF THE OUTBOARD TERMINUS         *
*         .                 OF THE I'TH LINE FOR THE CONTROL              *
*         .                 SURFACE, IN. (IN LOCAL COORDINATES)           *
*         .                                                               *
*         .  YTERM2(I)      Y COORDINATE OF THE OUTBOARD TERMINUS         *
*         .                 OF THE I'TH LINE FOR THE CONTROL              *
*        ...                SURFACE, IN. (IN LOCAL COORDINATES)           *
*                                                                         *
*        SEE FIGURES 6 AND 7.                                             *
*                                                                         *
*        FORMAT = (1I5, 4E10.0).  NUMBER OF CARDS IS 1 FOR THE            *
*        I'TH LINE.                                                       *
*                                                                         *
*        DATA ARE ENTERED BY SUBROUTINE MODAL.                            *
*                                                                         *
***************************************************************************
*                                                                         *
*        ENTER (EIGHT VALUES PER CARD), AND                               *
*        REPEAT THE FOLLOWING ITEM FOR J=1,...,NGP(I).                    *
*                                                                         *
* 27R ... YGP(J,I)          SPANWISE COORDINATES OF THE POINTS            *
*         .                 ALONG THE I'TH LINE AT WHICH INPUT            *
*         .                 MODAL DATA ARE GIVEN, IN. (IN LOCAL           *
*        ...                COORDINATES)                                  *
*                                                                         *
*        FORMAT = (8E10.0).  NUMBER OF CARDS IS (NGP(J)-1)/8 + 1          *
*        FOR THE I'TH LINE.                                               *
*                                                                         *
*        DATA ARE ENTERED BY SUBROUTINE MODAL.                            *
*                                                                         *
***************************************************************************
*                                                                         *
* 28R ... LOGIC ITEM          *** NO DATA ***                             *
*                                                                         *
*        IF TRANSLATION AND PITCH ROTATION ARE PRESCRIBED AT EACH         *
*        POINT (NELAXS = 1) ENTER DATA FOR THE FOLLOWING ITEM.            *
*        OTHERWISE (NELAXS = 0) OMIT THE FOLLOWING ITEM.                  *
*                                                                         *
***************************************************************************
*                                                                         *
* 29R ... DIST              AN ARBITRARY CHORDWISE DISTANCE FOR A         *
*         .                 CONTROL SURFACE FROM THE GIVEN LINE TO        *
*         .                 A REFERENCE LINE ON WHICH MODAL               *
*        ...                DISPLACEMENTS ARE CALCULATED, IN.             *
*                                                                         *
*        NOTE THAT MODAL DISPLACEMENTS ARE CALCULATED BY H1 = H0          *
*        + A0 * DIST, WHERE H0 AND A0 ARE THE DISPLACEMENT AND            *
*        ROTATION OF A POINT ON A GIVEN LINE AND H1 IS THE                *
*        DISPLACMENT OF THE CORRESPONDING POINT ON THE NEW LINE.          *
```

```
 ITEM      DATA       DESCRIPTION
 ----      ----       -----------

*      THE GIVEN DEFORMATIONS H0 AND A0 ALONG A LINE ARE, THUS,   *
*      CONVERTED TO DISPLACEMENTS H0 AND H1 ALONG TWO PARALLEL    *
*      LINES AND THE MODAL INTERPOLATION IS BASED ON THESE. SEE   *
*      FIGURE 7.                                                  *
*                                                                 *
*      FORMAT = (1E10.0).  NUMBER OF CARDS IS 1 FOR EACH          *
*      CONTROL SURFACE.                                           *
*                                                                 *
*      DATA ARE ENTERED BY SUBROUTINE FORM.                       *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*      3.  BODY SURFACE DATA ASSOCIATED WITH MODAL INTERPOLATION  *
*      -----------------------------------------------------------*
*                                                                 *
*******************************************************************
*                                                                 *
* 30R ... LOGIC ITEM       *** NO DATA ***                        *
*                                                                 *
*      IF BODIES THAT AERODYNAMICALLY INTERACT WITH SURFACES      *
*      ARE INCLUDED IN THE ANALYSIS (NB GREATER THAN ZERO)        *
*      ENTER DATA FOR THE FOLLOWING TWO ITEMS, OTHERWISE (NB =    *
*      0) OMIT THESE ITEMS.                                       *
*                                                                 *
*******************************************************************
*                                                                 *
*      REPEAT THE FOLLOWING TWO ITEMS FOR                         *
*      EACH BODY FOR J=1,...,NB                                   *
*                                                                 *
* 31R ... NGP          NUMBER OF POINTS ON THE J'TH BODY AXIS     *
*      .               AT WHICH MODAL DATA ARE PRESCRIBED.        *
*      .               MAXIMUM NUMBER IS TWENTY.                  *
*      .                                                          *
*      .   NSTRIP      NUMBER OF INTERFERENCE PANELS (OR          *
*      .               STRIPS) ASSOCIATED WITH THE J'TH BODY.     *
*      .               INTERFERENCE PANELS ARE ALLOWED TO BE      *
*      .               ONLY ONE ELEMENT WIDE (NS = 2 IN ITEM      *
*      .               6R).  A PARTICULARLY WIDE PANEL SHOULD     *
*      .               BE REPLACED WITH TWO OR MORE PANELS.       *
*      .                                                          *
*      .   IPANEL      INDEX OF THE FIRST SUCH INTERFERENCE       *
*      ...             PANEL ASSOCIATED WITH THE J'TH BODY.       *
*                                                                 *
*      FORMAT = (3I5).  NUMBER OF CARDS IS 1.                     *
*                                                                 *
*      DATA ARE ENTERED BY SUBROUTINE BEIN.                       *
*                                                                 *
*******************************************************************
*                                                                 *
*      ENTER (SIX VALUES PER CARD), AND                           *
*      REPEAT THE FOLLOWING ITEM FOR J=1,...,NGP                  *
```

```
ITEM       DATA          DESCRIPTION
----       ----          -----------

* 32R ... XGP(J)        STREAMWISE COORDINATES OF EACH POINT AT       *
*      .                WHICH MODAL DATA ARE PRESCRIBED, IN.          *
*      ...              (IN LOCAL COORDINATES)                        *
*                                                                     *
*      FORMAT = (6E10.0).  NUMBER OF CARDS IS (NGP-1)/6 + 1.          *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE BEIN.                           *
*                                                                     *
***********************************************************************
*                                                                     *
* 33R ... KLUGLB = 1 PRINT GLOBAL GEOMETRY.                           *
*      .              THIS IS THE GEOMETRY AFTER                      *
*      .              TRANSFORMATIONS XO(I), YO(I), ZO(I),            *
*      .              AND GGMAS(I) AND XBO(J), YBO(J), AND            *
*      .              ZBO(J) HAVE BEEN APPLIED.                       *
*      ...        = 0 NO DISPLAY                                      *
*                                                                     *
*      FORMAT = (1I5).  NUMBER OF CARDS IS 1.                         *
*                                                                     *
*      DATA ARE ENTERED BY SUBROUTINE RODDEN.                         *
*                                                                     *
***********************************************************************
```

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*******************************************************************
*                                                                 *
*                                                                 *
*     C.  SUPERSONIC AERODYNAMICS USING MACH BOX PROCEDURE        *
*     ------------------------------------------------------      *
*                                                                 *
*******************************************************************
*                                                                 *
*  1M ... LOGIC ITEM          *** NO DATA ***                     *
*                                                                 *
*     IF THE MACH BOX PROCEDURE IS TO BE USED (LC(21) = 2)        *
*     ENTER DATA FOR ITEMS TWO TO TWENTY SEVEN. OTHERWISE         *
*     (LC(21) DOES NOT EQUAL 2) OMIT THESE ITEMS.                 *
*                                                                 *
*******************************************************************
*                                                                 *
*  2M ... KSURF  = T     AT LEAST ONE OF THE PRIMARY SURFACES     *
*     .                  HAS A CONTROL SURFACE.                   *
*     .          = F     NO CONTROL SURFACE.                      *
*     .                  WHEN A CONTROL SURFACE IS PRESENT,       *
*     .                  MODAL INTERPOLATION IS DONE              *
*     .                  SEPARATELY OVER THE AREA AFT OF THE      *
*     .                  CONTROL SURFACE LEADING EDGE.            *
*     .                  CONSEQUENTLY, MODES ARE DISCONTINUOUS    *
*     .                  CHORDWISE AT THE CONTROL SURFACE         *
*     .                  LEADING EDGE AND SPANWISE AT THE         *
*     .                  CONTROL SURFACE EDGES. SEE FIGURES 5     *
*     .                  AND 6.                                   *
*     .                                                           *
*     .   NBEL   = T     BOX ELIMINATION IS TO BE USED IN THE     *
*     .                  DIAPHRAGM REGION.                        *
*     .          = F     NO ELIMINATION.                          *
*     .                                                           *
*     .   NPIF   = T     LIST PRESSURE INFLUENCE COEFFICIENTS.    *
*     .          = F     NO DISPLAY.                              *
*     .                                                           *
*     .   LINC   = T     LIST AIC MATRIX.                         *
*     .                  IF LC(22) = -1 LET LINC = F.             *
*     ...        = F     NO DISPLAY.                              *
*                                                                 *
*     FORMAT = (4L5).  NUMBER OF CARDS IS 1.                      *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE MACH.                        *
*                                                                 *
*******************************************************************
*                                                                 *
*  3M ... LOGIC ITEM          *** NO DATA ***                     *
*                                                                 *
*     IF A SURFACE HAS ONE OR MORE CONTROL SURFACES (KSURF =      *
*     T) ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE (KSURF =    *
*     F) OMIT THIS ITEM.                                          *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*****************************************************************
*                                                               *
*     ENTER (FIVE VALUES PER CARD), AND                         *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....,LC(3)              *
*                                                               *
*   4M ... NCSS(I)       NUMBER OF CONTROL SURFACES ON EACH     *
*     .                  PRIMARY SURFACE.                       *
*     ...                MAXIMUM NUMBER IS FIVE.                *
*                                                               *
*     FORMAT = (5I5).  NUMBER OF CARDS IS (LC(3)-1)/5 + 1.      *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE MACH.                      *
*                                                               *
*****************************************************************
*                                                               *
*     ENTER (FIVE VALUES PER CARD), AND                         *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....,LC(3)              *
*                                                               *
*   5M ... NSAA(I)       CLUES FOR THE AERODYNAMIC SYMMETRY ON  *
*     .                  EACH SURFACE.                          *
*     .            = 1   SYMMETRICAL ABOUT Y = 0.               *
*     .            =-1   ANTISYMMETRICAL                        *
*     ...          = 0   NO SYMMETRY ABOUT Y = 0.               *
*                                                               *
*     WHEN NSAA(I) = 1 OR -1, THE EFFECTS OF A REFLECTION OF    *
*     THE SURFACE ABOUT Y = 0 ARE INCLUDED WITH EITHER A        *
*     SYMMETRICAL OR ANTISYMMETRICAL RESULTANT LOADING.  WHEN   *
*     NSAA(I) = 0 NO SURFACE REFLECTION EXISTS.                 *
*                                                               *
*     FORMAT = (5I5).  NUMBER OF CARDS IS (LC(3)-1)/5 + 1.      *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE MACH.                      *
*                                                               *
*****************************************************************
*                                                               *
*   6M ... LOGIC ITEM         *** NO DATA ***                   *
*                                                               *
*     IF LIFT AND MOMENT COEFFICIENTS ARE TO BE LISTED (LC(8)   *
*     = 1) ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE (LC(8)  *
*     = 0) OMIT THIS ITEM.                                      *
*                                                               *
*****************************************************************
*                                                               *
*     ENTER (FIVE VALUES PER CARD), AND                         *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....,LC(3)              *
*                                                               *
*   7M ... KPLOT(I)      CLUES FOR DISPLAYING PRESSURES AND     *
*     .                  STABILITY COEFFICIENTS ON EACH         *
*     .                  PRIMARY SURFACE.                       *
*     .             = 1 DISPLAY.                                *
*     ...           = 0 DO NOT DISPLAY                          *
```

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*     FORMAT = (5I5).  NUMBER OF CARDS IS (LC(3)-1)/5 + 1.         *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE MACH.                          *
*                                                                   *
*********************************************************************
*                                                                   *
*  8M ... LOGIC ITEM          *** NC DATA ***                      *
*                                                                   *
*     IF BOX ELIMINATION IS TO BE USED IN THE DIAPHRAGM REGION     *
*     (NBEL = T) ENTER DATA FOR THE FOLLOWING ITEM. OTHERWISE      *
*     (NBEL = F) OMIT THIS ITEM.                                   *
*                                                                   *
*********************************************************************
*                                                                   *
*     ENTER (FIVE VALUES PER CARD), AND                             *
*     REPEAT THE FOLLOWING ITEM FOR I=1,....,LC(3)                  *
*                                                                   *
*  9M ... BEX(I)          FOR EACH PRIMARY SURFACE THE DISTANCE     *
*     .                   FORWARD OF THE LEADING EDGE BEYOND        *
*     .                   WHICH THE DIAPRAGM BOXES ARE TO BE        *
*     ...                 ELIMINATED, IN.                           *
*                                                                   *
*     FORMAT = (5E10.0).  NUMBER OF CARDS IS (LC(3)-1)/5 + 1.      *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE MACH.                          *
*                                                                   *
*********************************************************************
*                                                                   *
* 10M ... LOGIC ITEM          *** NC DATA ***                      *
*                                                                   *
*     IF LIFT AND MOMENT COEFFICIENTS ARE TO BE LISTED (LC(8)      *
*     = 1) ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE (LC(8)     *
*     = 0) OMIT THIS ITEM.                                         *
*                                                                   *
*********************************************************************
*                                                                   *
*     REPEAT THE FOLLOWING ITEM FOR EACH                            *
*     PRIMARY SURFACE FOR I=1,....,LC(3)                            *
*                                                                   *
*     IF PRESSURES ARE TO BE DISPLAYED (KPLOT(I) = 1) ENTER        *
*     DATA FOR THE FOLLOWING ITEM, OTHERWISE (KPLOT(I) = 0)        *
*     OMIT THIS ITEM FOR THE I'TH SURFACE.                         *
*                                                                   *
* 11M ... LZ(I)           INDEX OF THE FIRST CHORD OF BOXES FOR     *
*     .                   WHICH PRESSURES ARE TO BE DISPLAYED.      *
*     .                   CONSIDER THE CHORDS TO BE NUMBERED        *
*     .                   CONSECUTIVELY FROM THE ROOT TO THE        *
*     .                   TIP STARTING WITH THE ROOT CHORD AS       *
*     .                   NUMBER ONE.                               *
*     .                                                             *
*     .   LINC(I)         NUMBER OF BOX CHORDS BETWEEN THE          *
*     .                   CHORDS AT WHICH THE PRESSURES ARE TO      *
```

```
ITEM      DATA          DESCRIPTION
----      ----          -----------

*     ...               BE PRINTED.                                      *
*                                                                        *
*     FORMAT = (2I5).   NUMBER OF CARDS IS LC(3).                        *
*                                                                        *
*     DATA ARE ENTERED BY SUBROUTINE MACH.                               *
*                                                                        *
**************************************************************************
*                                                                        *
*     REPEAT THE FOLLOWING SIXTEEN ITEMS FOR                             *
*     EACH PRIMARY SURFACE FOR I =1,...,LC(3)                            *
*                                                                        *
* 12M ... NCLER(I)      NUMBER OF LINE SEGMENTS TO DEFINE THE            *
*     .                 LEADING EDGE PLUS ONE FOR THE I'TH               *
*     .                 PRIMARY SURFACE.                                 *
*     .                 MAXIMUM NUMBER IS TWENTY.                        *
*     .                                                                  *
*     .   NCTER(I)      NUMBER OF LINE SEGMENTS TO DEFINE THE            *
*     .                 TRAILING EDGE PLUS ONE FOR THE I'TH              *
*     .                 PRIMARY SURFACE.                                 *
*     .                 MAXIMUM NUMBER IS TWENTY.                        *
*     .                                                                  *
*     .   NWBT(I)       NUMBER OF MACH BOXES DESIRED ON THE              *
*     .                 SURFACE. MAXIMUM NUMBER IS THREE                 *
*     ...               HUNDRED AND FIFTY. (SEE FIGURE 8)                *
*                                                                        *
*     FORMAT = (3I5).   NUMBER OF CARDS IS 1 FOR THE I'TH                *
*     SURFACE.                                                           *
*                                                                        *
*     DATA ARE ENTERED BY SUBROUTINE EVOVLE.                             *
*                                                                        *
**************************************************************************
*                                                                        *
*     ENTER (EIGHT VALUES PER CARD), AND                                 *
*     REPEAT THE FOLLOWING ITEM FOR J=1,...,NCLER(I)                     *
*                                                                        *
* 13M ... CLEXR(J,I)    X COORDINATE OF THE LEADING EDGE                 *
*     .                 BREAK, SEQUENTIALLY, INBOARD TO                  *
*     .                 OUTBOARD, IN.                                    *
*     .                                                                  *
*     .   CLEYR(J,I)    Y COORDINATE OF THE LEADING EDGE                 *
*     .                 BREAK, SEQUENTIALLY, INBOARD TO                  *
*     ...               OUTBOARD, IN.                                    *
*                                                                        *
*     BREAKS INCLUDE THE ROOT AND TIP.  SEE FIGURE 8.                    *
*                                                                        *
*     FORMAT = (8E10.0).  NUMBER OF CARDS IS (NCLER(I)-1)/4 +            *
*     1 FOR THE I'TH PRIMARY SURFACE.                                    *
*                                                                        *
*     DATA ARE ENTERED BY SUBROUTINE EVOVLE.                             *
*                                                                        *
**************************************************************************
```

```
ITEM      DATA             DESCRIPTION
----      ----             -----------

*     ENTER (EIGHT VALUES PER CARD), AND                                *
*     REPEAT THE FOLLOWING ITEM FOR J=1,...,NCTER(I)                    *
*                                                                       *
* 14M ... CTEXR(J,I)    X COORDINATE OF THE TRAILING EDGE               *
*      .                BREAK, SEQUENTIALLY, INBOARD TO                 *
*      .                OUTBOARD, IN.                                   *
*      .                                                                *
*      .  CTEYR(J,I)    Y COORDINATE OF THE TRAILING EDGE               *
*      .                BREAK, SEQUENTIALLY, INBOARD TO                 *
*     ...               OUTBOARD, IN.                                   *
*                                                                       *
*     BREAKS INCLUDE THE ROOT AND TIP.  SEE FIGURE 8.                   *
*                                                                       *
*     FORMAT = (8E10.0).  NUMBER OF CARDS IS (NCTER(I)-1)/4 +           *
*     1 FOR THE I'TH PRIMARY SURFACE.                                   *
*                                                                       *
*     DATA ARE ENTERED BY SUBROUTINE EVOVLE.                            *
*                                                                       *
*************************************************************************
*                                                                       *
*     1.  PRIMARY SURFACE DATA ASSOCIATED WITH                          *
*     ----------------------------------------                          *
*         MODAL INTERPOLATION                                           *
*         -------------------                                           *
*                                                                       *
* 15M ... NLINES        NUMBER OF LINES ON THIS SURFACE ALONG           *
*      .                WHICH MODAL DATA ARE INPUT.                     *
*      .                MAXIMUM NUMBER IS TWENTY.                       *
*      .                IF NELAXS = 1 (SEE VARIABLE BELOW)              *
*      .                LET NLINES = 1.                                 *
*      .                                                                *
*      .  NELAXS = 1    TRANSLATION AND PITCH ROTATION ARE              *
*      .                PRESCRIBED AT EACH INPUT POINT.                 *
*      .         = 0    ONLY TRANSLATION IS PRESCRIBED.                 *
*      .                                                                *
*      .  NICH          CONTROL WORD OPTION FOR THE TYPE OF             *
*      .                EXTRAPOLATION DONE IN THE CHORDWISE             *
*      .                DIRECTION, IN INTERPOLATING MODAL               *
*      .                DATA TO THE AERODYNAMICS GRID.                  *
*      .  NICH = 0      LINEAR.                                         *
*      .       = 1      QUADRATIC.                                      *
*      .       = 2      CUBIC.                                          *
*      .                                                                *
*      .  NISP          CONTROL WORD OPTION FOR THE TYPE OF             *
*      .                EXTRAPOLATION DONE IN THE SPANWISE              *
*      .                 DIRECTION, IN INTERPOLATING MODAL              *
*      .                DATA TO THE AERODYNAMICS GRID.                  *
*      .  NISP = 0      LINEAR.                                         *
*      .       = 1      QUADRATIC.                                      *
*     ...      = 2      CUBIC.                                          *
*                                                                       *
*     FORMAT = (4I5).   NUMBER OF CARDS IS 1.                           *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*     DATA ARE ENTERED BY SUBROUTINE MODAZ.                              *
*                                                                         *
***************************************************************************
*                                                                         *
*     MODAL DATA ARE PRESCRIBED, STARTING WITH THE MOST                   *
*     FORWARD, MOST INBOARD LINE AND PROCEEDING OUTBOARD AND              *
*     AFT.                                                                *
*                                                                         *
*     REPEAT THE FOLLOWING TWO ITEMS FOR I=1,....,NLINES                  *
*                                                                         *
* 16M ... NGP(I)          NUMBER OF POINTS ON THE I'TH LINE OF            *
*     .                   PRIMARY SURFACE AT WHICH THE MODAL              *
*     .                   DATA ARE SPECIFIED.                             *
*     .                   MAXIMUM NUMBER IS TWELVE.                       *
*     .                                                                   *
*     .   XTERM1(I)       X COORDINATE OF THE INBOARD TERMINUS            *
*     .                   OF THE I'TH LINE FOR THE PRIMARY                *
*     .                   SURFACE, IN.                                    *
*     .                                                                   *
*     .   YTERM1(I)       Y COORDINATE OF THE INBOARD TERMINUS            *
*     .                   OF THE I'TH LINE FOR THE PRIMARY                *
*     .                   SURFACE, IN.                                    *
*     .                                                                   *
*     .   XTERM2(I)       X COORDINATE OF THE OUTBOARD TERMINUS           *
*     .                   OF THE I'TH LINE FOR THE PRIMARY                *
*     .                   SURFACE, IN.                                    *
*     .                                                                   *
*     .   YTERM2(I)       Y COORDINATE OF THE OUTBOARD TERMINUS           *
*     .                   OF THE I'TH LINE FOR THE PRIMARY                *
*     ...                 SURFACE, IN.                                    *
*                                                                         *
*     SEE FIGURE 6.                                                       *
*                                                                         *
*     FORMAT = (1I5, 4E10.0).  NUMBER OF CARDS IS 1 FOR THE               *
*     I'TH LINE.                                                          *
*                                                                         *
*     DATA ARE ENTERED BY SUBROUTINE MODAZ.                               *
*                                                                         *
***************************************************************************
*                                                                         *
*     ENTER (EIGHT VALUES PER CARD), AND                                  *
*     REPEAT THE FOLLOWING ITEM FOR J=1,...,NGP(I).                       *
*                                                                         *
* 17M ... YGP(J,I)        SPANWISE COORDINATES OF THE POINTS              *
*     .                   ALONG THE I'TH LINE AT WHICH INPUT              *
*     ...                 MODAL DATA ARE GIVEN, IN.                       *
*                                                                         *
*     FORMAT = (8E10.0).  NUMBER OF CARDS IS (NGP(I)-1)/8 + 1             *
*     FOR THE I'TH LINE                                                   *
*                                                                         *
*     DATA ARE ENTERED BY SUBROUTINE MODAZ.                               *
```

```
 ITEM      DATA          DESCRIPTION
 ----      ----          -----------

*******************************************************************
*                                                                 *
* 18M ... LOGIC ITEM         *** NO DATA ***                      *
*                                                                 *
*     IF TRANSLATION AND PITCH ROTATION ARE PRESCRIBED AT EACH    *
*     POINT (NELAXS = 1) ENTER DATA FOR THE FOLLOWING ITEM.       *
*     OTHERWISE (NELAXS = 0) OMIT THE FOLLOWING ITEM.             *
*                                                                 *
*******************************************************************
*                                                                 *
* 19M ... DIST              AN ARBITRARY CHORDWISE DISTANCE FOR A *
*     .                     PRIMARY SURFACE FROM THE GIVEN LINE   *
*     .                     TO A REFERENCE LINE ON WHICH MODAL    *
*     ...                   DISPLACEMENTS ARE CALCULATED, IN.     *
*                                                                 *
*     NOTE THAT MODAL DISPLACEMENTS ARE CALCULATED BY H1 = H0     *
*     + A0 * DIST. WHERE H0 AND A0 ARE THE DISPLACEMENT AND       *
*     ROTATION OF A POINT ON A GIVEN LINE AND H1 IS THE           *
*     DISPLACEMENT OF THE CORRESPONDING POINT ON THE NEW LINE.    *
*     THE GIVEN DEFORMATIONS H0 AND A0 ALONG A LINE ARE, THUS,    *
*     CONVERTED TO DISPLACEMENTS H0 AND H1 ALONG TWO PARALLEL     *
*     LINES AND THE MODAL INTERPOLATION IS BASED ON THESE.        *
*                                                                 *
*     FORMAT = (1E10.0).  NUMBER OF CARDS IS 1 FOR EACH           *
*     PRIMARY SURFACE.                                            *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE FORM.                        *
*                                                                 *
*******************************************************************
*                                                                 *
* 20M ... LOGIC ITEM         *** NO DATA ***                      *
*                                                                 *
*     IF A PRIMARY SURFACE HAS ONE OR MORE CONTROL SURFACES       *
*     WITH FORWARD HINGE LINES (KSURF = T) AND THE I'TH           *
*     PRIMARY SURFACE HAS CONTROL SURFACES (NCSS(I) GREATER       *
*     THAN ZERO) ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE     *
*     (KSURF = F) AND (NCSS(I) = 0) OMIT THIS ITEM.               *
*                                                                 *
*******************************************************************
*                                                                 *
*     REPEAT THE FOLLOWING ITEM FOR J = 1,...., NCSS(I)           *
*     STARTING INBOARD AND PROCEEDING OUTBOARD                    *
*                                                                 *
* 21M ... X1(J)             X COORDINATE OF THE INBOARD TERMINUS  *
*     .                     OF THE J'TH CONTROL SURFACE LEADING   *
*     .                     EDGE, IN.                             *
*     .                                                           *
*     .   Y1(J)             Y COORDINATE OF THE INBOARD TERMINUS  *
*     .                     OF THE J'TH CONTROL SURFACE LEADING   *
*     .                     EDGE, IN.                             *
*     .                                                           *
*     .   X2(J)             X COORDINATE OF THE OUTBOARD TERMINUS *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*     .                   OF THE J'TH CONTROL SURFACE LEADING         *
*     .                   EDGE, IN.                                   *
*     .                                                               *
*     .   Y2(J)           Y COORDINATE OF THE OUTBOARD TERMINUS       *
*     .                   OF THE J'TH CONTROL SURFACE LEADING         *
*     ...                 EDGE, IN.                                   *
*                                                                     *
*     SEE FIGURE 6.                                                   *
*                                                                     *
*     FORMAT = (4E10.0).  NUMBER OF CARDS IS NCSS(I).                 *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE HELZ.                            *
*                                                                     *
***********************************************************************
*                                                                     *
*     2.  CONTROL SURFACE DATA ASSOCIATED WITH                        *
*     ------------------------------------------                      *
*         MODAL INTERPOLATION                                         *
*         -------------------                                         *
*                                                                     *
***********************************************************************
*                                                                     *
* 22M ... LOGIC ITEM         *** NO DATA ***                          *
*                                                                     *
*     IF A PRIMARY SURFACE HAS ONE OR MORE CONTROL SURFACES           *
*     WITH FORWARD HINGE LINES (KSURF= T) ENTER DATA FOR THE          *
*     FOLLOWING FIVE ITEMS OTHERWISE (KSURF = F) OMIT THESE           *
*     ITEMS.                                                          *
*                                                                     *
***********************************************************************
*                                                                     *
*     THE FOLLOWING FIVE ITEMS ARE ENTERED ONCE AND ARE               *
*     APPLICABLE TO ALL THE CONTROL SURFACES.  ACTUALLY ITEMS         *
*     DEPENDENT UPON THE VARIABLE NLINES ARE ASSOCIATED WITH          *
*     ALL CONTROL SURFACES.                                           *
*                                                                     *
* 23M ... NLINES          NUMBER OF LINES ON THIS CONTROL             *
*     .                   SURFACE ALONG WHICH MODAL DATA ARE          *
*     .                   INPUT.                                      *
*     .                   MAXIMUM NUMBER IS TWENTY.                   *
*     .                   IF NELAXS = 1 (SEE VARIABLE BELOW)          *
*     .                   LET NLINES = 1.                             *
*     .                                                               *
*     .   NELAXS = 1      TRANSLATION AND PITCH ROTATION ARE          *
*     .                   PRESCRIBED AT EACH INPUT POINT.             *
*     .          = 0      ONLY TRANSLATION IS PRESCRIBED.             *
*     .                                                               *
*     .   NICH            CONTROL WORD OPTION FOR THE TYPE OF         *
*     .                   EXTRAPOLATION DONE IN THE CHORDWISE         *
*     .                   DIRECTION, IN INTERPOLATING MODAL           *
*     .                   DATA TO THE AERODYNAMICS GRID.              *
*     .   NICH = 0        LINEAR.                                     *
```

```
 ITEM      DATA          DESCRIPTION
 ----      ----          -----------

*      .          = 1     QUADRATIC.                                       *
*      .          = 2     CUBIC.                                           *
*      .                                                                   *
*      .   NISP           CONTROL WORD OPTION FOR THE TYPE OF              *
*      .                  EXTRAPOLATICN DONE IN THE SPANWISE               *
*      .                   DIRECTION, IN INTERPOLATING MODAL               *
*      .                  DATA TO THE AERODYNAMICS GRID.                   *
*      .   NISP = 0       LINEAR.                                          *
*      .          = 1     QUADRATIC.                                       *
*      ...        = 2     CUBIC.                                           *
*                                                                          *
*      FORMAT = (4I5).  NUMBER OF CARDS IS 1.                              *
*                                                                          *
*      DATA ARE ENTERED BY SUBROUTINE MODAZ.                               *
*                                                                          *
****************************************************************************
*                                                                          *
*      MODAL DATA ARE PRESCRIBED, STARTING WITH THE MOST                   *
*      FORWARD, MOST INBOARD LINE AND PROCEEDING OUTBOARD AND              *
*      AFT.                                                                *
*                                                                          *
*      REPEAT THE FOLLOWING TWO ITEMS FOR I=1,...,NLINES                   *
*                                                                          *
* 24M ... NGP(I)          NUMBER OF POINTS ON THE I'TH LINE OF             *
*      .                  CONTROL SURFACE AT WHICH THE MODAL               *
*      .                  DATA ARE SPECIFIED.                              *
*      .                  MAXIMUM NUMBER IS TWELVE.                        *
*      .                                                                   *
*      .   XTERM1(I)      X COORDINATE OF THE INBOARD TERMINUS             *
*      .                  OF THE I'TH LINE FOR THE CONTROL                 *
*      .                  SURFACE, IN.                                     *
*      .                                                                   *
*      .   YTERM1(I)      Y COORDINATE OF THE INBOARD TERMINUS             *
*      .                  OF THE I'TH LINE FOR THE CONTROL                 *
*      .                  SURFACE, IN.                                     *
*      .                                                                   *
*      .   XTERM2(I)      X COORDINATE OF THE OUTBOARD TERMINUS            *
*      .                  OF THE I'TH LINE FOR THE CONTROL                 *
*      .                  SURFACE, IN.                                     *
*      .                                                                   *
*      .   YTERM2(I)      Y COORDINATE OF THE OUTBOARD TERMINUS            *
*      .                  OF THE I'TH LINE FOR THE CONTROL                 *
*      ...                SURFACE, IN.                                     *
*                                                                          *
*      SEE FIGURES 6 AND 7.                                                *
*                                                                          *
*      FORMAT = (1I5, 4E10.0).  NUMBER OF CARDS IS 1 FOR THE               *
*      I'TH LINE.                                                          *
*                                                                          *
*      DATA ARE ENTERED BY SUBROUTINE MODAZ.                               *
*                                                                          *
****************************************************************************
```

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*     ENTER (EIGHT VALUES PER CARD), AND                            *
*     REPEAT THE FOLLOWING ITEM FOR J=1,....,NGP(I).                *
*                                                                   *
* 25M ... YGP(J,I)       SPANWISE COORDINATES OF THE POINTS         *
*      .                 ALONG THE I'TH LINE AT WHICH INPUT         *
*      ...               MODAL DATA ARE GIVEN, IN.                  *
*     FORMAT = (8E10.0).  NUMBER OF CARDS IS (NGP(I)-1)/8 + 1       *
*     FOR THE I'TH LINE                                             *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE MODAZ.                         *
*                                                                   *
*********************************************************************
*                                                                   *
* 26M ... LOGIC ITEM          *** NO DATA ***                       *
*                                                                   *
*     IF TRANSLATION AND PITCH ROTATION ARE PRESCRIBED AT EACH      *
*     POINT (NELAXS = 1) ENTER DATA FOR THE FOLLOWING ITEM.         *
*     OTHERWISE (NELAXS = 0) OMIT THE FOLLOWING ITEM.               *
*                                                                   *
*********************************************************************
*                                                                   *
* 27M ... DIST           AN ARBITRARY CHORDWISE DISTANCE FOR A      *
*      .                 CONTROL SURFACE FROM THE GIVEN LINE        *
*      .                 TO A REFERENCE LINE ON WHICH MODAL         *
*      ...               DISPLACEMENTS ARE CALCULATED, IN.          *
*                                                                   *
*     NOTE THAT MODAL DISPLACEMENTS ARE CALCULATED BY H1 = H0       *
*     + A0 * DIST, WHERE H0 AND A0 ARE THE DISPLACEMENT AND         *
*     ROTATION OF A POINT ON A GIVEN LINE AND H1 IS THE             *
*     DISPLACEMENT OF THE CORRESPONDING POINT ON THE NEW LINE.      *
*     THE GIVEN DEFORMATIONS H0 AND A0 ALONG A LINE ARE, THUS,      *
*     CONVERTED TO DISPLACEMENTS H0 AND H1 ALONG TWO PARALLEL       *
*     LINES AND THE MODAL INTERPOLATION IS BASED ON THESE. SEE      *
*     FIGURE 7.                                                     *
*                                                                   *
*     FORMAT = (1E10.0).  NUMBER OF CARDS IS 1 FOR EACH             *
*     CONTROL SURFACE.                                              *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE FORM.                          *
*                                                                   *
*********************************************************************
```

```
ITEM      DATA           DESCRIPTION
----      ----           -----------

****************************************************************
*                                                              *
*     D.  SUBSONIC AERODYNAMICS USING ASSUMED-                 *
*         ------------------------------------                 *
*         PRESSURE-FUNCTION PROCEDURE (KERNEL)                 *
*         ------------------------------------                 *
*                                                              *
****************************************************************
*                                                              *
*  1K ... LOGIC ITEM        *** NO DATA ***                    *
*                                                              *
*     IF THE ASSUMED-PRESSURE-FUNCTION PROCEDURE IS TO BE USED *
*     (LC(21) = 3) ENTER DATA FOR ITEMS TWO TO TWENTY EIGHT.   *
*     OTHERWISE (LC(21) DOES NOT EQUAL 3) OMIT THESE ITEMS.    *
*                                                              *
****************************************************************
*                                                              *
*  2K ... NLKG = 1      DISPLAY MATRIX WHICH GIVES DOWNWASH    *
*     .                 DUE TO UNIT VALUES OF PRESSURE         *
*     .                 POLYNOMIAL COEFFICIENTS (MATRIX L).    *
*     .         = 0     NO DISPLAY.                            *
*     .                                                        *
*     .  NLKF = 1       DISPLAY KERNEL FUNCTION VALUES.        *
*     ...       = 0     NO DISPLAY.                            *
*                                                              *
*     FORMAT = (2I5).   NUMBER OF CARDS IS 1.                  *
*                                                              *
*     DATA ARE ENTERED BY SUBROUTINE KERN.                     *
*                                                              *
****************************************************************
*                                                              *
*  3K ... LOGIC ITEM        *** NO DATA ***                    *
*                                                              *
*     IF PRESSURE INFLUENCE COEFFICIENTS ARE TO BE LISTED      *
*     (NLKG = 1) ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE  *
*     (NLKG = 0) OMIT THIS ITEM.                               *
*                                                              *
****************************************************************
*                                                              *
*     ENTER (ONE VALUE PER CARD)                               *
*                                                              *
*  4K ... LKG(1)         INDEX OF SURFACE FOR WHICH L MATRIX   *
*     ...                WILL BE LISTED.                       *
*                                                              *
*     FORMAT = (1I5).   NUMBER OF CARDS IS 1.                  *
*                                                              *
*     DATA ARE ENTERED BY SUBROUTINE KERN.                     *
*                                                              *
****************************************************************
*                                                              *
*  5K ... LOGIC ITEM        *** NO DATA ***                    *
```

```
 ITEM      DATA           DESCRIPTION
 ----      ----           -----------

*      IF KERNEL FUNCTION VALUES ARE TO BE LISTED (NLKF = 1)       *
*      ENTER DATA FOR THE FOLLOWING ITEM, OTHERWISE (NLKF = 0)     *
*      OMIT THIS ITEM.                                             *
*                                                                  *
********************************************************************
*                                                                  *
*      ENTER (ONE VALUE PER CARD)                                  *
*                                                                  *
*   6K ... LKF(1)          INDEX OF SURFACE FOR WHICH KERNEL       *
*      .                   FUNCTION VALUES ARE TO BE LISTED.       *
*      ...                 (EXPECT LARGE AMOUNT OF OUTPUT.)        *
*                                                                  *
*      FORMAT = (1I5).   NUMBER OF CARDS IS 1.                     *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE KERN.                        *
*                                                                  *
********************************************************************
*                                                                  *
*      REPEAT THE FOLLOWING TWO ITEMS FOR EACH                     *
*      PRIMARY SURFACE FOR I=1,....LC(3)                           *
*                                                                  *
*   7K ... MCP(I)          NUMBER OF TERMS IN THE CHORDWISE        *
*      .                   PRESSURE FUNCTION FOR THE I'TH          *
*      .                   PRIMARY SURFACE.                        *
*      .                   MAXIMUM NUMBER IS FIVE.                 *
*      .                                                           *
*      .   MC(I)           NUMBER OF COLLOCATION POINTS PER        *
*      .                   CHORD FOR THE I'TH PRIMARY SURFACE.     *
*      .                   MAXIMUM NUMBER IS TEN WITH A MINIMUM    *
*      .                   NUMBER OF TWO.                          *
*      .                                                           *
*      .   NC(I)           A FACTOR DEFINING THE NUMBER OF         *
*      .                   INTEGRATION POINTS PER CHORD FOR THE    *
*      .                   I'TH PRIMARY SURFACE.                   *
*      .                   NOTE THIS NUMBER IS THE LOWEST          *
*      .                   INTEGRAL VALUE OF (MC(I) + 1/2) * (2    *
*      .                   * NC(I) - 1).                           *
*      .                   MAXIMUM NC IS 12 AND MAXIMUM NUMBER     *
*      ...                 OF INTEGRATION POINTS IS 60.            *
*                                                                  *
*      SEE FIGURE 9.                                               *
*                                                                  *
*      FORMAT = (3I5).   NUMBER OF CARDS IS 1 FOR THE I'TH         *
*      SURFACE.                                                    *
*                                                                  *
*      DATA ARE ENTERED BY SUBROUTINE KERN.                        *
*                                                                  *
********************************************************************
*                                                                  *
*   8K ... IRP(I)          TWICE THE NUMBER OF TERMS IN THE        *
*      .                   SPANWISE PRESSURE FUNCTION.             *
*      .                   MAXIMUM NUMBER IS TEN WITH A MINIMUM    *
```

```
 ITEM      DATA          DESCRIPTION
 ----      ----          -----------

*      .                 NUMBER OF TWO.                              *
*      .                                                             *
*      .   IRC(I)        NUMBER OF COLLOCATION STATIONS ON THE       *
*      .                 ENTIRE SPAN.                                *
*      .                 MAXIMUM NUMBER IS TWENTY WITH A             *
*      .                 MINIMUM NUMBER OF FOUR.                     *
*      .                                                             *
*      .   NRS(I)        A FACTOR DEFINING THE NUMBER OF             *
*      .                 INTEGRATION STATIONS ON THE SPAN            *
*      .                 NOTE THIS NUMBER IS EQUAL TO NRSS(I)        *
*      .                 = NRS(I) * (IRC(I) + 1).                    *
*      .                 MAXIMUM NRSS IS ONE HUNDRED WITH A          *
*      ...               MINIMUM NRS OF THREE.                       *
*                                                                    *
*      FORMAT = (3I5).  NUMBER OF CARDS IS 1 FOR THE I'TH           *
*      PRIMARY SURFACE.                                              *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE KERN.                          *
*                                                                    *
**********************************************************************
*                                                                    *
*      REPEAT THE FOLLOWING THREE ITEMS FOR EACH                     *
*      PRIMARY SURFACE FOR I=1,...,LC(3).                            *
*                                                                    *
*   9K ... AB(I)         ROOT SEMICHORD OF THE I'TH PRIMARY          *
*      .                 SURFACE, IN.                                *
*      .                                                             *
*      .   AL(I)         SEMISPAN OF THE I'TH PRIMARY SURFACE,       *
*      .                 IN.                                         *
*      .                                                             *
*      .   BTP(I)        TIP SEMICHORD OF THE I'TH PRIMARY           *
*      .                 SURFACE, IN.                                *
*      .                                                             *
*      .   IKM(I) = 0    AIRLOADS SYMMETRIC ABOUT Y = 0.             *
*      .          = 1    AIRLOADS ANTISYMMETRIC.                     *
*      .                                                             *
*      .   NPR(I) = 1    IF LC(7) = 1.                               *
*      .          = 0    IF LC(7) = 0.                               *
*      .                                                             *
*      .   NCLA(I) = 1   IF LC(8) = 1.                               *
*      ...         = 0   IF LC(8) = 0.                               *
*                                                                    *
*      SEE FIGURE 10.                                                *
*                                                                    *
*      FORMAT = (3E10.0, 3I5).  NUMBER OF CARDS IS 1 FOR THE         *
*      I'TH PRIMARY SURFACE.                                         *
*                                                                    *
*      DATA ARE ENTERED BY SUBROUTINE KERN.                          *
*                                                                    *
**********************************************************************
*                                                                    *
* 10K ... LOGIC ITEM        *** NC DATA ***                          *
```

```
ITEM      DATA           DESCRIPTION
----      ----           -----------

*     IF PRESSURES ARE TO BE LISTED (LC(7) = 1) OR LIFT AND       *
*     MOMENT COEFFICIENTS ARE TO BE LISTED (LC(8) = 1) ENTER      *
*     DATA FOR THE FOLLOWING ITEM, OTHERWISE (LC(7) = 0 AND       *
*     LC(8) = 0) OMIT THIS ITEM.                                  *
*                                                                 *
*******************************************************************
*                                                                 *
* 11K ... NTEX(I)        NUMBER OF POINTS ALONG EACH CHORD AT     *
*     .                  WHICH PRESSURE ARE TO BE DISPLAYED.      *
*     .                  MAXIMUM NUMBER IS TWENTY WITH A          *
*     .                  MINIMUM NUMBER OF TWO.                   *
*     .                                                           *
*     .   NTEY(I)        NUMBER OF STATIONS PER SEMISPAN AT       *
*     .                  WHICH PRESSURES OR AERODYNAMIC FORCE     *
*     ...                COEFFICIENTS ARE TO BE DISPLAYED.        *
*                                                                 *
*     FORMAT = (2I5).    NUMBER OF CARDS IS 1 FOR THE I'TH        *
*     PRIMARY SURFACE.                                            *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE KERN                         *
*                                                                 *
*******************************************************************
*                                                                 *
*     REPEAT THE FOLLOWING ELEVEN ITEMS FOR                       *
*     EACH PRIMARY SURFACE FOR I =1,....,LC(3)                    *
*                                                                 *
* 12K ... NLE            NUMBER OF LINE SEGMENTS TO DEFINE THE    *
*     .                  LEADING EDGE PLUS ONE FOR THE I'TH       *
*     .                  PRIMARY SURFACE.                         *
*     .                  MAXIMUM NUMBER IS TWENTY.                *
*     .                                                           *
*     .   NTE            NUMBER OF LINE SEGMENTS TO DEFINE THE    *
*     .                  TRAILING EDGE PLUS ONE FOR THE I'TH      *
*     .                  PRIMARY SURFACE.                         *
*     ...                MAXIMUM NUMBER IS TWENTY.                *
*                                                                 *
*     SEE FIGURE 10.                                              *
*                                                                 *
*     FORMAT = (2I5).    NUMBER OF CARDS IS 1 FOR THE I'TH        *
*     SURFACE.                                                    *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE GEOM.                        *
*                                                                 *
*******************************************************************
*                                                                 *
*     ENTER (SIX VALUES PER CARD). AND                            *
*     REPEAT THE FOLLOWING ITEM FOR J=1,....,NLE                  *
*                                                                 *
* 13K ... XLE(J)         X COORDINATE OF THE LEADING EDGE         *
*     .                  BREAK, SEQUENTIALLY, INBOARD TO          *
*     .                  OUTBOARD, IN.                            *
```

```
ITEM      DATA            DESCRIPTION
----      ----            -----------

*     .   YLE(J)          Y COORDINATE OF THE LEADING EDGE          *
*     .                   BREAK, SEQUENTIALLY, INBOARD TO           *
*     ...                 OUTBOARD, IN.                             *
*                                                                   *
*     BREAKS INCLUDE THE ROOT AND TIP.  SEE FIGURE 10.              *
*                                                                   *
*     FORMAT = (6E10.0).  NUMBER OF CARDS IS (NLE - 1)/3 + 1        *
*     FOR THE I'TH PRIMARY SURFACE.                                 *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE GEOM.                          *
*                                                                   *
*********************************************************************
*                                                                   *
*     ENTER (SIX VALUES PER CARD), AND                              *
*     REPEAT THE FOLLOWING ITEM FOR J=1,....,NTE                    *
*                                                                   *
* 14K ... XTE(J)          X COORDINATE OF THE TRAILING EDGE         *
*     .                   BREAK, SEQUENTIALLY, INBOARD TO           *
*     .                   OUTBOARD, IN.                             *
*     .                                                             *
*     .   YTE(J)          Y COORDINATE OF THE TRAILING EDGE         *
*     .                   BREAK, SEQUENTIALLY, INBOARD TO           *
*     ...                 OUTBOARD, IN.                             *
*                                                                   *
*     BREAKS INCLUDE THE ROOT AND TIP.  SEE FIGURE 10.              *
*                                                                   *
*     FORMAT = (6E10.0).  NUMBER OF CARDS IS (NTE - 1)/3 + 1        *
*     FOR THE I'TH PRIMARY SURFACE.                                 *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE GEOM.                          *
*                                                                   *
*********************************************************************
*                                                                   *
* 15K ... KSURF = T       A SPANWISE DISCONTINUITY IS DESIRED       *
*     .                   IN THE SURFACE MODAL DEFLECTIONS AND      *
*     .                   A SECOND SPANWISE REGION OF               *
*     .                   INTERPOLATION IS CREATED.                 *
*     ...         = F     NOT DESIRED.                              *
*                                                                   *
*     SINCE THIS PROGRAM USES ASSUMED PRESSURE FUNCTIONS OVER       *
*     THE SURFACE AND THESE FUNCTIONS DO NOT ACCOUNT FOR THE        *
*     SINGULARITY THAT OCCURS AT A CONTROL SURFACE LEADING          *
*     EDGE, CONTROL SURFACE CANNOT BE CORRECTLY TREATED.            *
*      HOWEVER, SPANWISE DISCONTINUITIES, WHICH DO NOT INVOLVE      *
*     A SINGULARITY, CAN BE HANDLED.  THIS IS ACHIEVED BY           *
*     DEFINING A PSEUDO CONTROL SURFACE LEADING EDGE AHEAD OF       *
*     THE SPANWISE REGION WHERE THE DISCONTINUITY EXISTS.  SEE      *
*     FIGURE 7B.                                                    *
*                                                                   *
*     FORMAT = (1L5).  NUMBER OF CARDS IS 1.                        *
*                                                                   *
*     DATA ARE ENTERED BY SUBROUTINE GEOM.                          *
```

```
ITEM      DATA           DESCRIPTION
----      ----           -----------

*****************************************************************
*                                                               *
*     1.  PRIMARY SURFACE DATA ASSOCIATED WITH                  *
*     ----------------------------------------                  *
*         MODAL INTERPOLATION                                   *
*         -------------------                                   *
*                                                               *
* 16K ... NLINES          NUMBER OF LINES ON THIS SURFACE ALONG *
*     .                   WHICH MODAL DATA ARE INPUT.           *
*     .                   MAXIMUM NUMBER IS TWENTY.             *
*     .                   IF NELAXS = 1 (SEE VARIABLE BELOW)    *
*     .                   LET NLINES = 1.                       *
*     .                                                         *
*     .   NELAXS = 1      TRANSLATION AND PITCH ROTATION ARE    *
*     .                   PRESCRIBED AT EACH INPUT POINT.       *
*     .          = 0      ONLY TRANSLATION IS PRESCRIBED.       *
*     .                                                         *
*     .   NICH            CONTROL WORD OPTION FOR THE TYPE OF   *
*     .                   EXTRAPOLATION DONE IN THE CHORDWISE   *
*     .                   DIRECTION, IN INTERPOLATING MODAL     *
*     .                   DATA TO THE AERODYNAMICS GRID.        *
*     .   NICH = 0        LINEAR.                               *
*     .        = 1        QUADRATIC.                            *
*     .        = 2        CUBIC.                                *
*     .                                                         *
*     .   NISP            CONTROL WORD OPTION FOR THE TYPE OF   *
*     .                   EXTRAPOLATION DONE IN THE SPANWISE    *
*     .                    DIRECTION, IN INTERPOLATING MODAL    *
*     .                   DATA TO THE AERODYNAMICS GRID.        *
*     .   NISP = 0        LINEAR.                               *
*     .        = 1        QUADRATIC.                            *
*     ...      = 2        CUBIC.                                *
*                                                               *
*     FORMAT = (4I5).     NUMBER OF CARDS IS 1.                 *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE INTP.                      *
*                                                               *
*****************************************************************
*                                                               *
*     MODAL DATA ARE PRESCRIBED, STARTING WITH THE MOST         *
*     FORWARD, MOST INBOARD LINE AND PROCEEDING OUTBOARD AND    *
*     AFT.                                                      *
*                                                               *
*     REPEAT THE FOLLOWING TWO ITEMS FOR I=1,...,NLINES         *
*                                                               *
* 17K ... NGP(I)          NUMBER OF POINTS ON THE I'TH LINE OF  *
*     .                   PRIMARY SURFACE AT WHICH THE MODAL    *
*     .                   DATA ARE SPECIFIED.                   *
*     .                   MAXIMUM NUMBER IS TWELVE.             *
*     .                                                         *
*     .   XTERM1(I)       X COORDINATE OF THE INBOARD TERMINUS  *
*     .                   OF THE I'TH LINE FOR THE PRIMARY      *
```

```
ITEM      DATA           DESCRIPTION
----      ----           -----------

*       .                SURFACE, IN.                                 *
*       .                                                             *
*       .   YTERM1(I)    Y COORDINATE OF THE INBOARD TERMINUS         *
*       .                OF THE I'TH LINE FOR THE PRIMARY             *
*       .                SURFACE, IN.                                 *
*       .                                                             *
*       .   XTERM2(I)    X COORDINATE OF THE OUTBOARD TERMINUS        *
*       .                OF THE I'TH LINE FOR THE PRIMARY             *
*       .                SURFACE, IN.                                 *
*       .                                                             *
*       .   YTERM2(I)    Y COORDINATE OF THE OUTBOARD TERMINUS        *
*       .                OF THE I'TH LINE FOR THE PRIMARY             *
*       ...              SURFACE, IN.                                 *
*                                                                     *
*       SEE FIGURE 6.                                                 *
*                                                                     *
*       FORMAT = (1I5, 4E10.0).  NUMBER OF CARDS IS 1 FOR THE         *
*       I'TH LINE.                                                    *
*                                                                     *
*       DATA ARE ENTERED BY SUBROUTINE INTP.                          *
*                                                                     *
***********************************************************************
*                                                                     *
*       ENTER (EIGHT VALUES PER CARD), AND                            *
*       REPEAT THE FOLLOWING ITEM FOR J=1,....,NGP(I).                *
*                                                                     *
* 18K ... YGP(J)         SPANWISE COORDINATES OF THE POINTS           *
*       .                ALONG THE I'TH LINE AT WHICH INPUT           *
*       ...              MODAL DATA ARE GIVEN, IN.                    *
*                                                                     *
*       FORMAT = (8E10.0).  NUMBER OF CARDS IS (NGP(I)-1)/8 + 1       *
*       FOR THE I'TH LINE                                             *
*                                                                     *
*       DATA ARE ENTERED BY SUBROUTINE INTP.                          *
*                                                                     *
***********************************************************************
*                                                                     *
* 19K ... LOGIC ITEM          *** NO DATA ***                         *
*                                                                     *
*       IF TRANSLATION AND PITCH ROTATION ARE PRESCRIBED AT EACH      *
*       POINT (NELAXS = 1) ENTER DATA FOR THE FOLLOWING ITEM,         *
*       OTHERWISE (NELAXS = 0) OMIT THE FOLLOWING ITEM.               *
*                                                                     *
***********************************************************************
*                                                                     *
* 20K ... DIST           AN ARBITRARY CHORDWISE DISTANCE FOR A        *
*       .                PRIMARY SURFACE FROM THE GIVEN LINE          *
*       .                TO A REFERENCE LINE ON WHICH MODAL           *
*       ...              DISPLACEMENTS ARE CALCULATED, IN.            *
*                                                                     *
*       NOTE THAT MODAL DISPLACEMENTS ARE CALCULATED BY H1 = H0       *
*       + A0 * DIST, WHERE H0 AND A0 ARE THE DISPLACEMENT AND         *
```

```
ITEM      DATA          DESCRIPTION
----      ----          -----------

*     ROTATION OF A POINT ON A GIVEN LINE AND H1 IS THE              *
*     DISPLACEMENT OF THE CORRESPONDING POINT ON THE NEW LINE.       *
*     THE GIVEN DEFORMATIONS H0 AND A0 ALONG A LINE ARE, THUS,       *
*     CONVERTED TO DISPLACEMENTS H0 AND H1 ALONG TWO PARALLEL        *
*     LINES AND THE MODAL INTERPOLATION IS BASED ON THESE.           *
*                                                                    *
*     FORMAT = (1E10.0).  NUMBER OF CARDS IS 1 FOR EACH              *
*     PRIMARY SURFACE.                                               *
*                                                                    *
*     DATA ARE ENTERED BY SUBROUTINE FORK.                           *
*                                                                    *
**********************************************************************
*                                                                    *
* 21K ... LOGIC ITEM        *** NO DATA ***                          *
*                                                                    *
*     IF A PRIMARY SURFACE HAS A 'CONTROL SURFACE' WITH              *
*     FORWARD HINGE LINE (KSURF= T) ENTER DATA FOR THE               *
*     FOLLOWING ITEM, OTHERWISE (KSURF = F) OMIT THIS ITEM.          *
*                                                                    *
**********************************************************************
*                                                                    *
*     J = 1, ONE SURFACE ONLY.                                       *
*                                                                    *
* 22K ... X1(J)         X COORDINATE OF THE INBOARD TERMINUS         *
*     .                 OF THE J'TH CONTROL SURFACE LEADING          *
*     .                 EDGE, IN.                                    *
*     .                                                              *
*     .   Y1(J)         Y COORDINATE OF THE INBOARD TERMINUS         *
*     .                 OF THE J'TH CONTROL SURFACE LEADING          *
*     .                 EDGE, IN.                                    *
*     .                                                              *
*     .   X2(J)         X COORDINATE OF THE OUTBOARD TERMINUS        *
*     .                 OF THE J'TH CONTROL SURFACE LEADING          *
*     .                 EDGE, IN.                                    *
*     .                                                              *
*     .   Y2(J)         Y COORDINATE OF THE OUTBOARD TERMINUS        *
*     .                 OF THE J'TH CONTROL SURFACE LEADING          *
*     ...               EDGE, IN.                                    *
*                                                                    *
*     FORMAT = (4E10.0).  NUMBER OF CARDS IS NCS.                    *
*                                                                    *
*     DATA ARE ENTERED BY SUBROUTINE INTP.                           *
*                                                                    *
**********************************************************************
*                                                                    *
*     2.  'CONTROL SURFACE' DATA ASSOCIATED WITH                     *
*     ------------------------------------------                     *
*         MODAL INTERPOLATION                                        *
*         -------------------                                        *
*                                                                    *
**********************************************************************
```

```
 ITEM      DATA          DESCRIPTION
 ----      ----          -----------

* 23K ... LOGIC ITEM        *** NO DATA ***                           *
*                                                                     *
*     IF A PRIMARY SURFACE HAS A 'CONTROL SURFACE' WITH               *
*     FORWARD HINGE LINE (KSURFT = T) ENTER DATA FOR THE              *
*     FOLLOWING FIVE ITEMS, OTHERWISE (KSURF = F) OMIT THESE          *
*     ITEMS.                                                          *
*                                                                     *
***********************************************************************
*                                                                     *
*     THE FOLLOWING FIVE ITEMS ARE ENTERED ONCE.                      *
*                                                                     *
* 24K ... NLINES             NUMBER OF LINES ON THIS CONTROL          *
*     .                      SURFACE ALONG WHICH MODAL DATA ARE       *
*     .                      INPUT.                                   *
*     .                      MAXIMUM NUMBER IS TWENTY.                *
*     .                      IF NELAXS = 1 (SEE VARIABLE BELOW)       *
*     .                      LET NLINES = 1.                          *
*     .                                                               *
*     .   NELAXS = 1         TRANSLATION AND PITCH ROTATION ARE       *
*     .                      PRESCRIBED AT EACH INPUT POINT.          *
*     .          = 0         ONLY TRANSLATION IS PRESCRIBED.          *
*     .                                                               *
*     .   NICH               CONTROL WORD OPTION FOR THE TYPE OF      *
*     .                      EXTRAPOLATION DONE IN THE CHORDWISE      *
*     .                      DIRECTION, IN INTERPOLATING MODAL        *
*     .                      DATA TO THE AERODYNAMICS GRID.           *
*     .   NICH = 0           LINEAR.                                  *
*     .        = 1           QUADRATIC.                               *
*     .        = 2           CUBIC.                                   *
*     .                                                               *
*     .   NISP               CONTROL WORD OPTION FOR THE TYPE OF      *
*     .                      EXTRAPOLATION DONE IN THE SPANWISE       *
*     .                       DIRECTION, IN INTERPOLATING MODAL       *
*     .                      DATA TO THE AERODYNAMICS GRID.           *
*     .   NISP = 0           LINEAR.                                  *
*     .        = 1           QUADRATIC.                               *
*     ...      = 2           CUBIC.                                   *
*                                                                     *
*     FORMAT = (4I5).        NUMBER OF CARDS IS 1.                    *
*                                                                     *
*     DATA ARE ENTERED BY SUBROUTINE INTP.                            *
*                                                                     *
***********************************************************************
*                                                                     *
*     MODAL DATA ARE PRESCRIBED, STARTING WITH THE MOST               *
*     FORWARD, MOST INBOARD LINE AND PROCEEDING OUTBOARD AND          *
*     AFT.                                                            *
*                                                                     *
*     REPEAT THE FOLLOWING TWO ITEMS FOR I=1,...,NLINES               *
*                                                                     *
* 25K ... NGP(I)             NUMBER OF POINTS ON THE I'TH LINE OF     *
*     .                      CONTROL SURFACE AT WHICH THE MODAL       *
```

```
 ITEM      DATA            DESCRIPTION
 ----      ----            -----------

*      .                   DATA ARE SPECIFIED.                          *
*      .                   MAXIMUM NUMBER IS TWELVE.                    *
*      .                                                                *
*      .   XTERM1(I)       X COORDINATE OF THE INBOARD TERMINUS         *
*      .                   OF THE I'TH LINE FOR THE CONTROL             *
*      .                   SURFACE, IN.                                 *
*      .                                                                *
*      .   YTERM1(I)       Y COORDINATE OF THE INBOARD TERMINUS         *
*      .                   OF THE I'TH LINE FOR THE CONTROL             *
*      .                   SURFACE, IN.                                 *
*      .                                                                *
*      .   XTERM2(I)       X COORDINATE OF THE OUTBOARD TERMINUS        *
*      .                   OF THE I'TH LINE FOR THE CONTROL             *
*      .                   SURFACE, IN.                                 *
*      .                                                                *
*      .   YTERM2(I)       Y COORDINATE OF THE OUTBOARD TERMINUS        *
*      .                   OF THE I'TH LINE FOR THE CONTROL             *
*      ...                 SURFACE, IN.                                 *
*                                                                       *
*      SEE FIGURES 6 AND 7.                                             *
*                                                                       *
*      FORMAT = (1I5, 4E10.0).  NUMBER OF CARDS IS 1 FOR THE            *
*      I'TH LINE.                                                       *
*                                                                       *
*      DATA ARE ENTERED BY SUBROUTINE INTP.                             *
*                                                                       *
*************************************************************************
*                                                                       *
*      ENTER (EIGHT VALUES PER CARD), AND                               *
*      REPEAT THE FOLLOWING ITEM FOR J=1,...,NGP(I).                    *
*                                                                       *
* 26K ... YGP(J)           SPANWISE COORDINATES OF THE POINTS           *
*      .                   ALONG THE I'TH LINE AT WHICH INPUT           *
*      ...                 MODAL DATA ARE GIVEN, IN.                    *
*                                                                       *
*      FORMAT = (8E10.0).  NUMBER OF CARDS IS (NGP(I)-1)/8 + 1          *
*      FOR THE I'TH LINE                                                *
*                                                                       *
*      DATA ARE ENTERED BY SUBROUTINE INTP.                             *
*                                                                       *
*************************************************************************
*                                                                       *
* 27K ... LOGIC ITEM           *** NO DATA ***                          *
*                                                                       *
*      IF TRANSLATION AND PITCH ROTATION ARE PRESCRIBED AT EACH         *
*      POINT (NELAXS = 1) ENTER DATA FOR THE FOLLOWING ITEM.            *
*      OTHERWISE (NELAXS = 0) OMIT THE FOLLOWING ITEM.                  *
*                                                                       *
*************************************************************************
*                                                                       *
* 28K ... DIST             AN ARBITRARY CHORDWISE DISTANCE FOR A        *
*      .                   CONTROL SURFACE FROM THE GIVEN LINE          *
```

```
 ITEM      DATA          DESCRIPTION
 ----      ----          -----------

*       .               TO A REFERENCE LINE ON WHICH MODAL          *
*       ...             DISPLACEMENTS ARE CALCULATED, IN.           *
*                                                                   *
*       NOTE THAT MODAL DISPLACEMENTS ARE CALCULATED BY H1 = H0     *
*       + A0 * DIST, WHERE H0 AND A0 ARE THE DISPLACEMENT AND       *
*       ROTATION OF A POINT ON A GIVEN LINE AND H1 IS THE           *
*       DISPLACEMENT OF THE CORRESPONDING POINT ON THE NEW LINE.    *
*       THE GIVEN DEFORMATIONS H0 AND A0 ALONG A LINE ARE, THUS,    *
*       CONVERTED TO DISPLACEMENTS H0 AND H1 ALONG TWO PARALLEL     *
*       LINES AND THE MODAL INTERPOLATION IS BASED ON THESE.        *
*                                                                   *
*       FORMAT = (1E10.0).  NUMBER OF CARDS IS 1 FOR EACH           *
*       CONTROL SURFACE.                                            *
*                                                                   *
*       DATA ARE ENTERED BY SUBROUTINE FORK.                        *
*                                                                   *
*********************************************************************
```

```
ITEM      DATA               DESCRIPTION
----      ----               -----------

************************************************************
*                                                          *
*                                                          *
*             AFOM - AUTOMATED FLUTTER OPTIMIZATION MODULE *
*             -------------------------------------------- *
*                                                          *
*     I.  PREPARATION OF CARD DATA                         *
*     ----------------------------                         *
*                                                          *
************************************************************
*                                                          *
*  1. ... LOGIC ITEM          *** NO DATA ***              *
*                                                          *
*       IF KLUE(7) = 0, THE AUTOMATED FLUTTER OPTIMIZATION IS *
*     TURNED OFF AND ALL DATA ITEMS IN THIS MODULE ARE     *
*     IGNORED.                                             *
*                                                          *
************************************************************
*                                                          *
*  2. ... F000             IDENTIFIES THE BEGINNING OF THE CARD *
*      .                   INPUT DATA TO THE AUTOMATED FLUTTER *
*      .                   OPTIMIZATION MODULE (AFOM). MUST BE *
*     ...                  ENTERED AS SHOWN.               *
*                                                          *
*     USED WITHIN THE PROGRAM TO GENERATE THE PERTINENT TITLE *
*     AND REFERENCE PAGE NUMBER APPEARING IN THE TABLE OF  *
*     CONTENTS AT THE END OF EACH EXECUTION.  REMAINING    *
*     COLUMNS (FIVE TO SEVENTY TWO) MAY BE USED FOR ANY    *
*     DESCRIPTIVE INFORMATION THE USER WISHES TO INCLUDE.  *
*                                                          *
*     ------------                                         *
*     |0000000001|                                         *
*     |1234567890|                                         *
*     |----------|                                         *
*     |F000      |                                         *
*     ------------                                         *
*                                                          *
*     FORMAT = (1A4).  NUMBER OF CARDS IS 1.               *
*                                                          *
*     DATA ARE ENTERED BY SUBROUTINE AFOM AND SUBROUTINE LDB *
*     WHERE IT IS PASSED TO SUBROUTINE DTABLE TO GENERATE THE *
*     PROPER HEADING FOR THE TABLE OF CONTENTS.            *
*                                                          *
************************************************************
*                                                          *
*                                                          *
*     ENTER (SIXTEEN WORDS PER CARD)                       *
*     FOR THE FOLLOWING ITEM FOR L=1,....,16.              *
*                                                          *
*  3. ... TSHFO(L)         SUBTITLE CONSISTING OF ONE CARD. *
*                                                          *
*     WILL BE LISTED AFTER THE MAIN TITLE AT THE TOP OF EACH *
```

```
*     PAGE OF THE LISTED RESULTS AND WILL BE USED TO DESCRIBE     *
*     THE FLUTTER REDESIGN BEING PERFORMED.  THE SUBTITLE IS      *
*     INCREASED TO EIGHTEEN WORDS WITHIN THE PROGRAMS WHERE       *
*     THE LAST TWO WORDS ARE USED TO IDENTIFY THE PROGRAM FROM    *
*     WHICH RESULTS ARE LISTED.                                   *
*                                                                 *
*     FORMAT = (16A4).  NUMBER OF CARDS IS 1.                     *
*                                                                 *
*     DATA ARE ENTERED BY THE SUBROUTINE AFOM.                    *
*                                                                 *
*******************************************************************
*                                                                 *
*                                                                 *
*        ALL CLUE VALUES INCLUDING ZEROS MAY BE ENTERED IF THE    *
*     USER SO DESIRES.  IF THE USER WISHES TO MINIMIZE THE        *
*     AMOUNT OF DATA, HE MAY ENTER ONLY NON-ZERO CLUE VALUES      *
*     ACCORDING TO THE PROCEDURE DISCUSSED IN 'CONTROL WORD       *
*     OPTION' SECTION.  REGARDLESS OF WHICH APPROACH IS TAKEN     *
*     THE LAST NON-ZERO VALUE (IF ANY) MUST BE PRECEDED BY A      *
*     NEGATIVE SIGN.                                              *
*                                                                 *
*  4. ... KLUFO( 1) = 0 DO NOT LIST THE TRANSFORMATION            *
*     .                    MATRIX, QT, BETWEEN STRUCTURAL AND     *
*     .                    MODAL DISPLACEMENTS.                   *
*     .             = 1 LIST THE TRANSFORMATION MATRIX, QT,       *
*     .                    BETWEEN STRUCTURAL AND MODAL           *
*     .                    DISPLACEMENTS.                         *
*     .                                                           *
*     .   KLUFO( 2) = 0 DO NOT LIST THE FLUTTER VECTORS U         *
*     .                    AND V (AS NEEDED IN THE                *
*     .                    FLUTTER-VELOCITY DERIVATIVE            *
*     .                    EXPRESSION) IN STRUCTURAL              *
*     .                    COORDINATES.                           *
*     .             = 2 LIST U AND V FLUTTER VECTORS IN           *
*     .                    STRUCTURAL COORDINATES.                *
*     .                                                           *
*     .   KLUFO( 3) = 0 DO NOT LIST THE INCREMENTAL MASS AND      *
*     .                    STIFFNESS MATRICES (STRUCTURAL         *
*     .                    COORDINATES) ASSOCIATED WITH EACH      *
*     .                    FLUTTER REDESIGN CYCLE.                *
*     .             = 3 LIST THE INCREMENTAL MASS AND             *
*     .                    STIFFNESS MATRICES (STRUCTURAL         *
*     .                    COORDINATES) ASSOCIATED WITH EACH      *
*     .                    FLUTTER REDESIGN CYCLE. NOTE THAT      *
*     .                    THIS CLUE IS IGNORED IF KLUE(34) =     *
*     .                    0.                                     *
*     .                                                           *
*     .   KLUFO( 4) = 0 DO NOT LIST THE OLD AND INCREMENTAL       *
*     .                    MASS AND STIFFNESS MATRICES (MODAL     *
*     .                    COORDINATES) ASSOCIATED WITH EACH      *
*     .                    FLUTTER REDESIGN CYCLE.                *
*     .             = 4 LIST THE OLD AND INCREMENTAL MASS         *
```

```
ITEM      DATA                DESCRIPTION
----      ----                -----------

*       .                    AND STIFFNESS MATRICES (MODAL            *
*       .                    COORDINATES) ASSOCIATED WITH EACH        *
*       .                    FLUTTER REDESIGN CYCLE. NOTE THAT        *
*       .                    THIS CLUE IS IGNORED IF KLUE(34) =       *
*       ...                  0.                                       *
*                                                                     *
*       FORMAT = (10I4).     NUMBER OF CARDS IS 1.                    *
*                                                                     *
*       DATA ARE ENTERED BY THE SUBROUTINE AFOM THROUGH THE           *
*       SUBROUTINE CLUES.                                             *
*                                                                     *
***********************************************************************
*                                                                     *
*       REDESIGN PARAMETERS (SEE FIGURE 1.)                           *
*                                                                     *
***********************************************************************
*                                                                     *
*   5. ... LOGIC ITEM          *** NO DATA ***                        *
*                                                                     *
*                                                                     *
*       IF FLUTTER REDESIGN IS TO BE PERFORMED, (KLUE(7) = 7 AND      *
*       KLUE(34) =  34), ENTER THE FOLLOWING THREE ITEMS.             *
*        OTHERWISE, OMIT THESE ITEMS.                                 *
*                                                                     *
***********************************************************************
*                                                                     *
*   6. ... VDES              DESIRED FLUTTER SPEED FOR THE            *
*       .                    CURRENT FOP RUN, (KNOTS EQUIVALENT       *
*       .                    AIRSPEED).                               *
*       .                                                             *
*       .  EPS1              PARAMETER WHICH, TOGETHER WITH VDES,     *
*       .                    DEFINES THE WIDTH OF THE FLUTTER         *
*       .                    BAND, B.  B = VDES*EPS1.  VALUES OF      *
*       .                    FLUTTER SPEED, VF, WHICH ARE GREATER     *
*       .                    THAN OR EQUAL TO VDES BUT LESS THAN      *
*       .                    OR EQUAL TO (VDES + B) ARE SAID TO       *
*       .                    BE IN THE FLUTTER BAND.                  *
*       .                                                             *
*       .  DWMAX             WEIGHT PARAMETER USED TO TEST FOR        *
*       .                    DESIGN CONVERGENCE. IF, IN A GIVEN       *
*       .                    FOP STEP, TWO SUCCESSIVE DESIGNS         *
*       .                    HAVE FLUTTER SPEEDS WHICH FALL           *
*       .                    WITHIN THE FLUTTER BAND, THE DESIGN      *
*       .                    IS SAID TO BE CONVERGED IF THE TWO       *
*       .                    DESIGN WEIGHTS ARE WITHIN DWMAX OF       *
*       .                    EACH OTHER.  THE LAST DESIGN IS          *
*       .                    ACCEPTED AS THE FINAL DESIGN AND THE     *
*       ...                  PROGRAM EXITS.                           *
*                                                                     *
*       FORMAT = (3F10.3). NUMBER OF CARDS IS 1.                      *
*                                                                     *
*       DATA ARE ENTERED BY SUBROUTINE AFOM.                          *
```

```
 ITEM      DATA            DESCRIPTION
 ----      ----            -----------

*****************************************************************
*                                                               *
*  7. ... NBAR             PARAMETER GOVERNING FLUTTER SPEED    *
*     .                    STEP SIZE.  THE FOP PROGRAM WILL     *
*     .                    ATTEMPT TO ATTAIN A FLUTTER SPEED IN *
*     .                    THE CENTER OF THE FLUTTER BAND. (VF  *
*     .                    = VDES + B/2), IN NBAR               *
*     .                    (APPROXIMATELY) EQUAL FLUTTER SPEED  *
*     .                    INCREMENTS.  AFTER NBAR REDESIGNS,   *
*     .                    EACH SUBSEQUENT REDESIGN WILL AIM    *
*     .                    FOR THE CENTER OF THE FLUTTER BAND.  *
*     .                                                         *
*     .   NFIX             MAXIMUM NUMBER OF FLUTTER REDESIGNS. *
*     .                     THE FOP PROGRAM WILL PERFORM NFIX   *
*     .                    FLUTTER REDESIGNS UNLESS THE DESIGN  *
*     .                    CONVERGES IN LESS THAN NFIX          *
*     ...                  REDESIGNS.                           *
*                                                               *
*     FORMAT = (2I5). NUMBER OF CARDS IS 1.                     *
*                                                               *
*     DATA ARE ENTERED BY SUBROUTINE AFOM.                      *
*                                                               *
*****************************************************************
*                                                               *
*  8. ... D                'MAX CUT' PARAMETER FOR STRUCTURAL   *
*     .                    MEMBERS.  WHEN A STRUCTURAL ELEMENT  *
*     .                    IS BEING RESIZED DOWNWARD BY THE     *
*     .                    FLUTTER RESIZING ALGORITHM, ITS NEW  *
*     .                    SIZE IS NOT PERMITTED TO BE LESS     *
*     .                    THAN D TIMES THE OLD SIZE, (TNEW IS  *
*     .                    EQUAL TO OR GREATER THAN D*TOLD).    *
*     .                     NOTE ALSO THAT TNEW IS NOT          *
*     .                    PERMITTED TO FALL BELOW THE ELEMENTS *
*     .                    MINIMUM MANUFACTURING SIZE OR        *
*     .                    MINIMUM STRESS SIZE AS PRESCRIBED BY *
*     .                    SOP. SUGGESTED VALUE, D = 0.0.       *
*     .                                                         *
*     .   DBAL             'MAX CUT' PARAMETER FOR MASS BALANCE *
*     .                    VARIABLES.  WHEN A MASS BALANCE      *
*     .                    VARIABLE IS BEING RESIZED DOWNWARD   *
*     .                    BY THE FLUTTER RESIZING ALGORITHM,   *
*     .                    ITS NEW WEIGHT IS NOT PERMITTED TO   *
*     .                    BE LESS THAN DBAL TIMES THE OLD      *
*     .                    WEIGHT, (WNEW IS EQUAL TO OR GREATER *
*     .                    THAN DBAL*WOLD). SUGGESTED VALUE,    *
*     .                    DBAL = 0.0.                          *
*     .                                                         *
*     .                      THE PARAMETERS VDES, EPS1, AND     *
*     .                    NBAR, SPECIFIED PREVIOUSLY, CONTROL  *
*     .                    THE REQUIRED FLUTTER SPEED CHANGE    *
*     .                    FOR EACH REDESIGN CYCLE. THE PROGRAM *
*     .                    ATTEMPTS TO ACHIEVE EACH PRESCRIBED  *
```

```
 ITEM      DATA            DESCRIPTION
 ----      ----            -----------

*     .                    FLUTTER SPEED CHANGE USING AN          *
*     .                    ITERATIVE LINEAR PREDICTOR             *
*     .                    TECHNIQUE.  THE NEXT TWO PARAMETERS    *
*     .                    - DEL AND EPS2 - CONTROL THE           *
*     .                    ACCEPTANCE CRITERIA FOR THE            *
*     .                    PREDICTED VS. REQUIRED FLUTTER SPEED   *
*     .                    CHANGE.                                *
*     .                                                           *
*     .    DEL             'ABSOLUTE TYPE' PARAMETER USED IN      *
*     .                    THE FLUTTER RESIZING SUBROUTINE. A     *
*     .                    TENTATIVE NEW DESIGN IS ACCEPTED IF    *
*     .                    THE PREDICTED FLUTTER SPEED STEP       *
*     .                    SIZE, DVLIN, IS WITHIN DEL OF THE      *
*     .                    DESIRED STEP SIZE. DVDES. THAT IS.     *
*     .                    IF ABS(DVLIN - DVDES) IS LESS THAN     *
*     .                    DEL. SUGGESTED VALUE. DEL = 1.0.       *
*     .                                                           *
*     .    EPS2            'RELATIVE TYPE' PARAMETER USED IN      *
*     .                    THE FLUTTER RESIZING SUBROUTINE. A     *
*     .                    TENTATIVE NEW DESIGN IS ACCEPTED IF    *
*     .                    THE RATIO OF THE PREDICTED STEP SIZE   *
*     .                    TO THE DESIRED STEP SIZE,              *
*     .                    DVLIN/DVDES. IS WITHIN EPS2 OF         *
*     .                    UNITY. THAT IS. IF ABS(DVLIN/DVDES -   *
*     .                    1.0) IS LESS THAN EPS2. SUGGESTED      *
*     ...                  VALUE. EPS2 = 0.05.                    *
*                                                                 *
*     FORMAT = (4F10.3). NUMBER OF CARDS IS 1.                    *
*                                                                 *
*     DATA ARE ENTERED BY SUBROUTINE AFOM.                        *
*                                                                 *
*******************************************************************
```

OUTPUT

MAIN PROGRAM (FOP)

THE MAIN PROGRAM CONTROLS THE LISTING OF THE FOUR ITEMS DISCUSSED BELOW. WHEREAS THE FIRST ITEM APPEARS AT THE VERY BEGINNING OF THE OUTPUT, THE OTHER THREE ITEMS APPEAR AT THE VERY END OF THE OUTPUT.

PROGRAM LISTING OF CARD DATA

THIS ITEM CONSISTS OF CARD IMAGES (COLUMNS 1 TO 80) OF ALL THE INPUT DATA SUPPLIED TO THE CURRENT RUN. TO FACILITATE INSPECTION OF THIS DATA, A SEQUENTIAL CARD NUMBER IS ASSOCIATED WITH EACH CARD IMAGE.

INPUT-OUTPUT MATRIX LABELS AS GENERATED WITHIN THE PROGRAM

THIS ITEM, WHICH IS OPTIONAL OUTPUT, SUMMARIZES ALL THE CALLS TO SUBROUTINES 'GEDLAB', 'PUDLAB', 'GEFLAB', AND 'PUFLAB' IN THE ORDER IN WHICH THEY OCCURRED WITHIN THE RUN. SUBROUTINES 'GEDLAB' AND 'PUDLAB' RESPECTIVELY READ AND WRITE LABELS OF FILES (PERMANENT OR SCRATCH) STORED ON DSIO UNITS. SIMILARLY, 'GEFLAB' AND 'PUFLAB' RESPECTIVELY READ AND WRITE LABELS (IF ANY) OF FILES (PERMANENT OR SCRATCH) STORED ON FSIO UNITS. ALTHOUGH THIS SUMMARY SERVES MAINLY AS A DEBUGGING AID, IT IS ALSO A QUICK REFERENCE TO ASCERTAIN THE LOCATION, NAME, AND SIZE OF ANY MATRIX OF INTEREST.

THE FOLLOWING QUANTITIES ARE PRESENTED FOR EACH CALL.

(CALLING PROGRAM) - THIS IS THE SUBROUTINE IN WHICH THE CALL ORIGINATED.

(CALLED PROGRAM) - THIS IS THE NAME OF THE CALLED SUBROUTINE. IT IS EITHER 'GEDLAB', 'PUDLAB', 'GEFLAB', OR 'PUFLAB'.

(UNIT NAME) - THIS QUANTITY IS NOT CURRENTLY USED.

(FILE NAME) - THIS IS THE NAME OF THE MATRIX, PSEUDO-MATRIX, OR OTHER DATA IN THE FILE.

(UNIT) - THIS IS THE LOGICAL UNIT ON WHICH THE DATA RESIDES.

(FILE) - THIS IS THE LOCATION OF THE DATA ON THE UNIT.

(ROWS, COLS) - IF THE FILE CONTAINS A MATRIX OR PSEUDO-MATRIX. THESE TWO QUANTITIES USUALLY DEFINE THE ACTUAL SIZE OF THE ARRAY. HOWEVER, IF THE SIZE IS NOT KNOWN PRIOR TO THE FORMATION OF THE ARRAY, OR IF THE DATA IS NOT IN THE FORM OF AN ARRAY, THESE TWO QUANTITIES ARE USED WITHIN THE PROGRAM BUT ARE OF NO INTEREST TO THE USER.

(PAGE) - THE OUTPUT HAD REACHED THIS PAGE OF THE LISTING WHEN THE CALL WAS MADE.

INPUT-OUTPUT MATRIX LABELS IN NUMERICAL ORDER OF I/O UNITS

THIS ITEM, WHICH IS ALSO OPTIONAL OUTPUT, IS IDENTICAL TO THE PREVIOUS ITEM EXCEPT THAT THE CALLS ARE ORDERED ACCORDING TO I/O UNIT RATHER THAN IN THE ORDER IN WHICH THEY WERE EXECUTED. THIS SUMMARY SERVES AS A QUICK REFERENCE TO DETERMINE THE DATA STORED ON ANY PARTICULAR UNIT.

TABLE OF CONTENTS

A TABLE OF CONTENTS IS SUPPLIED TO AID THE USER IN LOCATING SOME MAJOR OUTPUT ITEMS IN THE LISTING.

AVAM - AUTOMATED VIBRATION ANALYSIS MODULE

AS SHOWN IN THE SUMMARY BELOW, THE OUTPUT ITEMS IN AVAM BELONG TO THREE GENERAL CATEGORIES. CATEGORY (A) CONTAINS THOSE ITEMS THAT CAN APPEAR IN THE FIRST FOP PASS ONLY. ITEMS THAT APPEAR IN EVERY FOP PASS BELONG TO CATEGORY (B). CATEGORY (C) CONTAINS ITEMS THAT APPEAR IN ALL FOP PASSES EXCEPT THE FIRST.

SUMMARY OF OUTPUT ITEMS FOR AVAM

1(B). STRESS RATIOS
2(A). STRUCTURAL MEMBERS EXCLUDED FROM FLUTTER REDESIGN
3(A). NON-OPTIMUM FACTORS
4(B). DESIGN ARRAY
5(B). MASS BALANCE
6(C). WEIGHT SUMMARY
7(B). TRANSFORMATION MATRIX 'B'
8(A). INITIAL AND CURRENT WEIGHTS
9(C). INCREMENTAL MASS MATRICES (CUMULATIVE)
10(A). FIXED MASS ITEMS
11(A). WEIGHT PARAMETERS FOR AUTO-MASS GENERATOR
12(B). MASS MATRIX FROM AUTO-MASS GENERATOR (STRUCT. COORD)
13(A). PLUG MASS DATA
14(B). MASS MATRIX FOR VIBRATION ANALYSIS
15(B). FLEXIBILITY OR STIFFNESS MATRIX
16(B). VIBRATION FREQUENCIES
17(B). PLUG MOTION IN EACH MODE
18(B). ABSOLUTE MODE SHAPES
19(B). GENERALIZED MASS (FLEXIBLE MODES)
20(B). GENERALIZED MASS (RIGID-BODY MODES)
21(B). ORTHOGONALIZATION AND MOMENTUM CHECK
22(B). MODAL VECTORS FOR FLUTTER ANALYSIS
23(B). CALCOMP PLOTTING OF VIBRATION MODES

THESE OUTPUT ITEMS ARE DISCUSSED IN THE FOLLOWING MATERIAL.

ITEM 1(B). STRESS RATIOS

STRESS RATIOS (ACTUAL STRESS DIVIDED BY ALLOWABLE STRESS) ARE LISTED FOR ALL 'ACTIVE' STRUCTURAL MEMBERS IN SOP. THAT IS, A RATIO IS NOT SHOWN FOR ANY MEMBER WHICH CAN NEVER BE RESIZED IN SOP BECAUSE ITS MINIMUM AND MAXIMUM ALLOWABLE GAGES (AS SPECIFIED BY THE USER) ARE IDENTICAL. NOTE THAT THESE STRESS RATIOS APPLY TO THE CURRENT DESIGN BEING PASSED TO FOP FROM SOP. NATURALLY, THIS ITEM WILL NOT APPEAR IF THE PREVIOUS SOP RUN DID NOT ANALYZE THE STRUCTURE BUT MERELY COMPUTED THE STIFFNESS OR FLEXIBILITY MATRIX. ALSO, THE ITEM WILL NOT APPEAR IN THE FIRST FOP PASS UNLESS FOP IS BEING CALLED UPON TO PERFORM A FLUTTER REDESIGN.

ITEM 2(A). STRUCTURAL MEMBERS EXCLUDED FROM FLUTTER REDESIGN

IF THE USER HAS PERMANENTLY EXCLUDED ANY ELEMENTS FROM THE FLUTTER REDESIGN PROCESS, THE PROGRAM WILL PROVIDE A LIST OF THE EXCLUDED MEMBER NUMBERS. THE TOTAL NUMBER OF EXCLUDED ELEMENTS WILL ALSO BE GIVEN.

ITEM 3(A). NON-OPTIMUM FACTORS

IF THE USER HAS PROVIDED NON-OPTIMUM FACTORS, THE PROGRAM WILL PROVIDE A LIST OF MEMBER NUMBERS AND THE ASSOCIATED NON-OPTIMUM FACTORS. THE TOTAL NUMBER OF SUCH MEMBERS WILL ALSO BE GIVEN.

ITEM 4(B). DESIGN ARRAY

THE DESIGN ARRAY CONTAINS PERTINENT DATA FOR EACH OF THE STRUCTURAL MEMBERS WHICH MAY TAKE PART IN THE FLUTTER RESIZING PROCESS. FOR EACH SUCH MEMBER, THE FOLLOWING SEVEN QUANTITIES ARE LISTED.

(MEMB) - MEMBER NUMBER

(NEWT) - CURRENT GAGE

(OLDT) - GAGE AS IT ENTERED PREVIOUS SOP PASS
(THIS QUANTITY IS SET TO ZERO IN THE FIRST FOP PASS)

(INITT) - GAGE AFTER THE FIRST SOP PASS. THIS IS CONSIDERED
TO BE THE STARTING GAGE FOR THE ENTIRE FLUTTER AND

STRENGTH RESIZING PROCESS. IN THE FIRST FOP PASS, THIS QUANTITY WILL BE IDENTICAL TO 'NEWT'.

(MINT) - MINIMUM ALLOWABLE GAGE FOR FLUTTER REDESIGN IN THIS FOP PASS. THIS QUANTITY IS THE LARGER OF TWO VALUES. IT IS EITHER THE MINIMUM MANUFACTURING GAGE, OR THE GAGE WHICH WILL CAUSE THE ELEMENT TO BE FULLY STRESSED (PRODUCT OF STRESS RATIO AND CURRENT GAGE).

(MAXT) - MAXIMUM ALLOWABLE GAGE FOR FLUTTER REDESIGN IN THIS FOP PASS. IF A MAXIMUM ALLOWABLE WAS NOT SPECIFIED, THIS QUANTITY WILL BE LISTED AS ZERO.

(WPUT) - WEIGHT PER UNIT GAGE OF MEMBER

NOTE... AS THIS ITEM IS ASSOCIATED WITH THE FLUTTER REDESIGN PROCESS, IT WILL NOT APPEAR IN A FIRST PASS THROUGH FOP UNLESS FLUTTER REDESIGN IS TO BE PERFORMED.

ITEM 5(B). MASS BALANCE

IF MASS BALANCE IS PRESENT IN THE PROBLEM, THE PROGRAM WILL LIST THE FOLLOWING QUANTITIES FOR EACH MASS BALANCE VARIABLE.

FIRST PASS THROUGH FOP.....
(NUMBER) - USER SUPPLIED IDENTIFICATION NUMBER FOR THE VARIABLE
(WEIGHT) - STARTING WEIGHT OF THE VARIABLE
(DOF) - THREE STRUCTURAL DEGREES OF FREEDOM ASSOCIATED WITH THE VARIABLE

SUBSEQUENT PASSES THROUGH FOP.....
THE OUTPUT IS SIMILAR TO THAT OF THE FIRST FOP PASS EXCEPT THAT BOTH THE INITIAL (STARTING) WEIGHT AND THE CURRENT WEIGHT ARE GIVEN FOR EACH VARIABLE. IF THE USER HAS SUPERSEDED MASS BALANCE DATA IN THIS FOP PASS, THE CURRENT WEIGHTS REFLECT THE NEW DATA RATHER THAN THE WEIGHTS AS THEY EXISTED AT THE END OF THE PREVIOUS PASS THROUGH FOP.

ITEM 6(C). WEIGHT SUMMARY

A WEIGHT SUMMARY IS PRESENTED AT THE BEGINNING OF ALL FOP PASSES-EXCEPT THE FIRST. THIS SUMMARY CONTAINS THE FOLLOWING INFORMATION.

1. INITIAL REFERENCE WEIGHT - THIS IS THE TOTAL WEIGHT OF THE STRUCTURE AS IT EXISTED AFTER THE INITIAL SOP PASS BUT BEFORE ANY FLUTTER RESIZING.

2. WEIGHT CHANGE IN LAST SOP PASS - THIS QUANTITY WILL BE ZERO

IF SOP WAS NOT USED TO REDESIGN THE STRUCTURE.

3. CUMULATIVE STRUCTURAL WEIGHT CHANGE - THIS IS THE TOTAL WEIGHT OF ALL STRUCTURAL MATERIAL ADDED TO THE DESIGN AFTER THE INITIAL SOP PASS. THIS WEIGHT MAY BE DUE TO BOTH STRENGTH AND FLUTTER RESIZING.

4. CUMULATIVE MASS BALANCE WEIGHT CHANGE - THIS IS SIMPLY THE SUM OF ALL MASS BALANCE WEIGHTS CURRENTLY IN THE DESIGN. IT IS NOT THE DIFFERENCE BETWEEN THE CURRENT MASS BALANCE WEIGHT AND THE INITIAL WEIGHT SPECIFIED BY THE USER IN THE FIRST FOP PASS.

5. CUMULATIVE TOTAL WEIGHT CHANGE - THIS IS THE SUM OF THE CUMULATIVE STRUCTURAL AND MASS BALANCE WEIGHT CHANGES.

6. PERCENTAGE WEIGHT CHANGE (CUMULATIVE) - THIS IS THE CUMULATIVE TOTAL WEIGHT CHANGE DIVIDED BY THE INITIAL REFERENCE WEIGHT (PCT)

7. TOTAL NEW WEIGHT - THIS IS THE SUM OF THE INITIAL REFERENCE WEIGHT AND THE CUMULATIVE TOTAL WEIGHT CHANGE.

ITEM 7(B). TRANSFORMATION MATRIX 'B'

THE 'B' MATRIX MAY BE LISTED AS OPTIONAL OUTPUT WHEN THE FLEXIBILITY APPROACH IS BEING USED. THE TRANSPOSE OF THIS MATRIX TRANSFORMS DISPLACEMENTS FROM THE DYNAMICS MODEL TO THE STRUCTURES MODEL. IF A FREE-FREE VIBRATION ANALYSIS IS BEING PERFORMED, THESE DISPLACEMENTS ARE IN RELATIVE COORDINATES. FOR A CANTILEVER ANALYSIS, THEY ARE IN ABSOLUTE COORDINATES.

ITEM 8(A). INITIAL AND CURRENT WEIGHTS

(NOTE - THIS ITEM WILL NOT APPEAR IF THE AUTOMATIC MASS GENERATOR IS USED.)

IF FLUTTER REDESIGN IS TO BE PERFORMED IN A FIRST FOP PASS, THE FOLLOWING TWO WEIGHTS ARE LISTED.

1. INITIAL WEIGHT - THIS (USER-SUPPLIED) QUANTITY IS THE TOTAL WEIGHT OF THE DESIGN AS IT ENTERS THE FIRST FOP PASS.

2. PRESENT TOTAL WEIGHT - THIS IS THE SUM OF THE INITIAL WEIGHT AND ANY MASS BALANCE WEIGHT THE USER SUPPLIED IN THE FIRST FOP PASS.

ITEM 9(C). INCREMENTAL MASS MATRICES (CUMULATIVE)

(NOTE - THIS ITEM WILL NOT APPEAR IF THE AUTOMATIC MASS GENERATOR IS USED.)

TWO INCREMENTAL MASS MATRICES MAY BE LISTED AS OPTIONAL OUTPUT IN ALL FOP PASSES (EXCEPT THE FIRST). THESE MATRICES ARE DISCUSSED BELOW.

1. INCREMENTAL MASS MATRIX (STRUCT. GRID) WITH RESPECT TO INITIAL MASS MATRIX MDB.

THIS INCREMENTAL MASS MATRIX IS ASSOCIATED WITH ALL THE CUMULATIVE STRENGTH-FLUTTER DESIGN CHANGES MADE TO THE STRUCTURE STARTING WITH THE FIRST FOP PASS. THE MATRIX IS IN STRUCTURAL COORDINATES AND IS THEREFORE DIAGONAL. ALL ZEROES, INCLUDING THOSE ON THE DIAGONAL, ARE SUPPRESSED. NOTE THAT THE ORIGINAL MASS BALANCE WEIGHTS IN THE FIRST FOP PASS ARE REPRESENTED IN THE INITIAL MASS MATRIX MDB AND ARE THEREFORE NOT INCLUDED IN THIS INCREMENTAL MATRIX.

2. INCREMENTAL MASS MATRIX (DYNAMIC GRID) WITH RESPECT TO INITIAL MASS MATRIX MDB.

IF THE FLEXIBILITY APPROACH IS BEING USED, THE INCREMENTAL MASS MATRIX (STRUCT. GRID) DISCUSSED ABOVE IS TRANSFORMED TO DYNAMICS COORDINATES. IF LISTED, THIS TRANSFORMED MATRIX IS DENOTED AS MATRIX DMDB.

ITEM 10(A). FIXED MASS ITEMS

(FIXED ADDITIONS TO MASS MATRIX (STRUCT. GRID))

IF THE AUTOMATIC MASS GENERATOR OPTION IS BEING USED, AND IF FIXED MASS ITEMS HAVE BEEN SUPPLIED BY THE USER, THESE ITEMS WILL BE LISTED IN THE FIRST FOP PASS. NOTE THAT THESE ITEMS ARE PRESCRIBED IN STRUCTURAL COORDINATES.

ITEM 11(A). WEIGHT PARAMETERS FOR AUTO-MASS GENERATOR

IF THE AUTOMATIC MASS GENERATOR IS BEING USED, THE FOLLOWING WEIGHT DATA WILL BE LISTED IF FLUTTER REDESIGN IS TO BE DONE IN THIS RUN.

1. INITIAL REFERENCE WEIGHT

THIS IS THE WEIGHT OF THE DESIGN BEFORE FLUTTER REDESIGN HAS COMMENCED. IT IS COMPUTED WITHIN FOP AND IS THE SUM OF THE STRUCTURAL WEIGHT AND THE WEIGHT OF ANY FIXED MASS ITEMS SUPPLIED BY THE USER. IT DOES NOT INCLUDE THE INITIAL MASS BALANCE WEIGHT.

2. CONTRIBUTION DUE TO STRUCTURE

THIS IS THE TOTAL STRUCTURAL WEIGHT (INCLUDING NON-OPTIMUM FACTORS).

3. CONTRIBUTION DUE TO FIXED MASS ITEMS
THE USER MUST SUPPLY THE TOTAL WEIGHT OF ANY FIXED MASS ITEMS IF FLUTTER REDESIGN IS DESIRED.

4. PRESENT TOTAL WEIGHT
THIS IS THE SUM OF THE INITIAL REFERENCE WEIGHT AND THE INITIAL MASS BALANCE WEIGHT.

ITEM 12(B). MASS MATRIX FROM AUTO-MASS GENERATOR (STRUCT. COORD)

IF THE AUTOMATIC MASS GENERATOR IS USED, THE MASS MATRIX AS COMPUTED IN STRUCTURAL COORDINATES CAN BE LISTED AS OPTIONAL OUTPUT WHEN THE FLEXIBILITY APPROACH IS USED. THE MATRIX IS DIAGONAL - EXCEPT FOR ANY OFF-DIAGONAL TERMS PRESENT IN THE FIXED MASS ITEMS. ALL ZEROES ARE SUPPRESSED.

ITEM 13(A). PLUG MASS DATA

IF A FREE-FREE VIBRATION ANALYSIS IS TO BE PERFORMED, THE USER-SUPPLIED PLUG MASS MATRIX IS LISTED IN THE FIRST FOP PASS.

ITEM 14(B). MASS MATRIX FOR VIBRATION ANALYSIS

THE LOWER TRIANGLE OF THE ACTUAL MASS MATRIX TO BE USED IN THE CURRENT VIBRATION ANALYSIS CAN BE LISTED AS OPTIONAL OUTPUT. THIS MATRIX REFLECTS THE DESIGN AS IT CURRENTLY EXISTS, INCLUDING FIXED MASS ITEMS, MASS BALANCE WEIGHTS, PLUG MASS, AND ANY CUMULATIVE WEIGHT DUE TO EARLIER STRENGTH-FLUTTER RESIZINGS. IF A CANTILEVER ANALYSIS IS BEING PERFORMED, THIS MATRIX IS DENOTED AS MD. IN A FREE-FREE ANALYSIS, THE NOTATION IS MDFF.

ITEM 15(B). FLEXIBILITY OR STIFFNESS MATRIX

DEPENDING ON THE APPROACH BEING USED, THE LOWER TRIANGLE OF THE DYNAMIC FLEXIBILITY MATRIX OR THE STRUCTURAL STIFFNESS MATRIX CAN BE LISTED AS OPTIONAL OUTPUT.

ITEM 16(B). VIBRATION FREQUENCIES

THE VIBRATION FREQUENCIES ARE ALWAYS LISTED IN ORDER OF INCREASING FREQUENCY.

ITEM 17(B). PLUG MOTION IN EACH MODE

WHEN A FREE-FREE ANALYSIS IS PERFORMED, THE PROGRAM PROVIDES A SEPARATE LIST OF THE PLUG MOTIONS IN EACH FLEXIBLE MODE. THESE MOTIONS ARE PART OF THE ABSOLUTE MODE SHAPES WHICH ARE NORMALIZED SUCH THAT THE LARGEST (ABSOLUTE) VALUE IN EACH MODE IS UNITY.

ITEM 18(B). ABSOLUTE MODE SHAPES

THE PROGRAM ALWAYS PROVIDES A LIST OF MODE SHAPES IN ABSOLUTE COORDINATES. EACH MODE IS NORMALIZED SUCH THAT THE LARGEST (ABSOLUTE) VALUE IN THE MODE IS UNITY.

ITEM 19(B). GENERALIZED MASS (FLEXIBLE MODES)

THE PROGRAM ALWAYS LISTS THE GENERALIZED MASS MATRIX ASSOCIATED WITH ALL FLEXIBLE MODES. EACH MODE USED IN THE COMPUTATION OF THIS ITEM HAD BEEN NORMALIZED SO THAT THE LARGEST (ABSOLUTE) VALUE IN EACH MODE WAS UNITY.

ITEM 20(B). GENERALIZED MASS (RIGID-BODY MODES)

WHEN A FREE-FREE VIBRATION ANALYSIS IS PERFORMED, THE PROGRAM WILL LIST THE GENERALIZED MASS ASSOCIATED WITH THE RIGID-BODY MODES. FOR THIS COMPUTATION, EACH RIGID-BODY MODE IS NORMALIZED SUCH THAT THE ASSOCIATED PLUG DISPLACEMENT IS UNITY. AS A RESULT, THE GENERALIZED MASS MATRIX WILL REFLECT THE ENTIRE MASS AND INERTIA OF THE DESIGN.

ITEM 21(B). ORTHOGONALIZATION AND MOMENTUM CHECK

WHEN FREE-FREE MODES ARE COMPUTED, THE PROGRAM WILL LIST THE GENERALIZED MASS FOR FLEXIBLE AND RIGID-BODY MODES. FOR EASE OF INSPECTION, THIS MATRIX IS NORMALIZED SUCH THAT ALL THE

DIAGONAL TERMS ARE UNITY. CROSS-TERMS BETWEEN THE FLEXIBLE AND RIGID-BODY MODES WILL CHECK THE ORTHOGONALITY OF THOSE MODES. EQUIVALENTLY, THESE CROSS-TERMS SERVE AS A CHECK ON THE MOMENTUM ASSOCIATED WITH THE COMPUTED FLEXIBLE FREE-FREE MODES.

ITEM 22(B). MODAL VECTORS FOR FLUTTER ANALYSIS

THE PROGRAM ALWAYS LISTS THE REDUCED MODAL VECTORS TO BE USED IN THE SUBSEQUENT FLUTTER ANALYSIS. THESE VECTORS ARE COMPRISED OF SELECTED COMPONENTS OF THE ORIGINAL (ABSOLUTE) MODE SHAPES PLUS ANY ADDITIONAL ZEROES THE USER HAS SPECIFIED. COLUMN 'INEW' INDICATES THE DEGREE OF FREEDOM NUMBERING SYSTEM FOR THE NEW REDUCED VECTOR. COLUMN 'IOLD' SPECIFIES THE DEGREES OF FREEDOM THAT THE SELECTED COMPONENTS HAD IN THE ORIGINAL VECTORS.

ITEM 23(B). CALCOMP PLOTTING OF VIBRATION MODES

THE FOLLOWING QUANTITIES ARE LISTED WHENEVER CALCOMP PLOTS OF THE VIBRATION MODES ARE GENERATED.

1. GEOMETRY OF PLOTTING GRID
THIS GRID CONSISTS OF ALL NODES AT WHICH MODAL DISPLACEMENTS MAY BE PLOTTED. THE X,Y AND Z COORDINATES OF EACH NODE ARE GIVEN, AND IN ADDITION, THE ALLOWABLE MOTION AT EACH NODE (X,Y OR Z) IS SPECIFIED.

2. BEAM DEFINITIONS
FOR EACH BEAM, THE PROGRAM WILL PRESENT THE ASSIGNED NAME AND THE CONNECTING NODES ASSOCIATED WITH THAT BEAM.

3. REFERENCE BEAM
THE NAME AND LENGTH OF THE REFERENCE BEAM SELECTED BY THE USER IS LISTED ALONG WITH THE RATIO OF MAXIMUM DISPLACEMENT TO REFERENCE BEAM LENGTH. THIS RATIO DEFINES THE SCALE OF PLOTTED MODAL AMPLITUDES IN TERMS OF THE PLOTTED LENGTH OF THE REFERENCE BEAM.

4. MODES TO BE PLOTTED
THE TOTAL NUMBER OF DESIRED PLOTS AND THE INDIVIDUAL MODES TO BE PLOTTED ARE SPECIFIED.

5. MODAL DISPLACEMENTS
FOR EACH MODE TO BE PLOTTED, THE PROGRAM LISTS THE MODAL DISPLACEMENTS AT ALL NODES IN THE PLOTTING GRID. THESE DISPLACEMENTS ARE PRESENTED BEFORE THEY ARE SCALED FOR PLOTTING.

CATEGORIES OF OUTPUT FOR AFAM

(A) GENERAL OUTPUT
(B) OUTPUT ASSOCIATED WITH DOUBLET LATTICE METHOD
(C) OUTPUT ASSOCIATED WITH MACH BOX METHOD
(D) OUTPUT ASSOCIATED WITH ASSUMED PRESSURE FUNCTION METHOD
(E) OUTPUT ASSOCIATED WITH K SOLUTION PROCEDURE
(F) OUTPUT ASSOCIATED WITH P-K SOLUTION PROCEDURE

ITEM 1(A). MODAL DATA

GENERALIZED MASS MATRIX, MODAL FREQUENCIES, AND COMPLEX GENERALIZED STIFFNESS MATRIX FOR MODES OF VIBRATION SPECIFIED AS INPUT TO AFAM. THE IMAGINARY COMPONENT OF ANY ON-DIAGONAL GENERALIZED STIFFNESS TERM REPRESENTS A MODAL DAMPING COEFFICIENT, WHICH MAY BE SPECIFIED BY THE USER.

ITEM 2(B). GEOMETRY OF AERODYNAMICS MODEL

DATA INCLUDES COORDINATES OF THE VERTICES (CORNERS) OF EACH AERODYNAMIC PANEL (XCAP,YCAP,ZCAP), THE COORDINATES OF THE VERTICES OF EACH AERODYNAMIC ELEMENT, THE X-COORDINATE OF THE PANEL LEADING EDGE AT THE CENTER OF EACH AERODYNAMIC STRIP (XIJ), AND THE PANEL CHORD LENGTH MEASURED AT THE CENTER OF EACH AERODYNAMIC STRIP (CWIG).

ITEM 3(C). GEOMETRY OF AERODYNAMICS MODEL

THE COORDINATES OF THE CENTER OF EACH SURFACE AERODYNAMIC BOX AND THE BOX AREA ARE PRESENTED IN BOTH NORMALIZED AND TRUE (INCHES) COORDINATES. THE X,Y COORDINATES ARE NORMALIZED SO THAT THE LENGTH AND WIDTH OF EACH COMPLETE BOX ARE EQUAL TO UNITY. THUS THE NORMALIZED AREA OF EACH BOX THAT LIES COMPLETELY (NOT PARTIALLY) ON THE MAIN SURFACE WILL BE UNITY. THE ORIGIN OF THE NORMALIZED COORDINATES IS THE CENTER OF THE MOST INBOARD, FORWARD BOX. THE ORIGIN OF THE TRUE COORDINATES IS THE INTERSECTION OF THE SURFACE ROOT CHORD AND THE SURFACE LEADING EDGE.

GEOMETRIC DATA FOR THE DIAPHRAGM BOXES IS PRESENTED IN A SIMILAR FORMAT TO THE SURFACE BOX DATA. THE COMPLETE GEOMETRY OF

THE AERODYNAMICS MODEL IS THEN SUMMARIZED IN A PRINT-PLOT WHICH INDICATES THE POSITIONS OF WING, DIAPHRAGM, AND SHARED (PARTIALLY WING, PARTIALLY DIAPHRAGM) BOXES.

ITEM 4(D). GEOMETRY OF AERODYNAMICS MODEL

THE NON-DIMENSIONAL ARRAYS OF COORDINATES Y/L(0), X/B(0), B/B(0) ARE DEFINED AS FOLLOWS. Y/L(0) IS THE ARRAY OF SPANWISE COORDINATES (NON-DIMENSIONALIZED BY SEMI-SPAN) OF STATIONS ALONG WHICH COLLOCATION POINTS ARE LOCATED. X/B(0) IS AN ARRAY OF MID-CHORD COORDINATES AT EACH OF THESE STATIONS MEASURED FROM THE ROOT MID-CHORD IN THE STREAMWISE DIRECTION AND NON-DIMENSIONALIZED BY THE ROOT SEMI-CHORD. B/B(0) IS AN ARRAY OF SEMI-CHORD LENGTHS AT THESE STATIONS, NON-DIMENSIONALIZED BY THE ROOT SEMI-CHORD. THE PARAMETERS ETA/L(0), XI/B(0), B/B(0) GIVE SIMILAR NON-DIMENSIONAL GEOMETRIC DATA FOR THE INTEGRATION POINTS.

ITEM 5(A). INPUT DATA FOR MODAL INTERPOLATION

THE COORDINATES OF THE TERMINAL POINTS OF SPANWISE LINES ON WHICH MODAL DEFLECTIONS ARE SPECIFIED, THE COORDINATES OF POINTS ON THE LINES WHERE MODAL DATA IS SPECIFIED, AND THE CORRESPONDING MODAL DEFLECTION ARRAYS, WHICH ARE INPUT FROM AVAM. THIS ITEM IS OPTIONAL OUTPUT.

ITEM 6(A). INTERPOLATED MODAL DATA

THE INTERPOLATED MODAL DEFLECTIONS ARE PRESENTED IN THE FORM OF THE COORDINATES OF THE INTERPOLATION POINT FOLLOWED BY THE ASSOCIATED INTERPOLATED DISPLACEMENT (H) AND SLOPE (ALPHA). THE UNITS OF (ALPHA) ARE RADIANS PER FOOT. THIS DATA, WHICH IS REPEATED FOR EACH MODE OF VIBRATION, IS OPTIONAL OUTPUT. THE INTERPOLATED DATA IS THEN PRESENTED IN THE FORM OF 'PRINT-PLOTS' FOR EASE OF INSPECTION. THESE PLOTS ARE NOT OPTIONAL OUTPUT.

THE INTERPOLATION POINTS FOR THE DOUBLET-LATTICE PROCEDURE ARE THE ELEMENT THREE-QUARTER CHORD POINTS. FOR THE MACH BOX PROCEDURE THEY ARE THE BOX CENTERS. FOR THE ASSUMED PRESSURE FUNCTION PROCEDURE, THEY ARE THE COLLOCATION (DOWNWASH) POINTS.

ITEM 7(D). INTERPOLATED MODAL DATA

FOR THE ASSUMED PRESSURE FUNCTION APPROACH, AN ITEM 'MODE

SHAPES FOR GENERALIZED AIR FORCES' FOLLOWS ITEM 6(A). THIS DATA GIVES THE COORDINATES OF LIFT POINTS AND THE INTERPOLATED MODAL DISPLACEMENTS AT THOSE POINTS.

ITEM 8(B). GENERALIZED FORCES PER UNIT DYNAMIC PRESSURE

COMPUTED GENERALIZED AIR FORCE MATRICES FOR THE BASE SET OF REDUCED FREQUENCIES USED FOR INTERPOLATION (MAXIMUM OF 6). IN ORDER TO CONFORM WITH THE ORIGINAL AFFDL VERSION OF THE DOUBLET LATTICE PROGRAM, THESE MATRICES ARE PRESENTED FOR UNIT DYNAMIC PRESSURE.

ITEM 9(A). GENERALIZED AIR FORCES

THE DISPLAY OF GENERALIZED AERODYNAMIC FORCE MATRICES, CORRESPONDING TO REDUCED FREQUENCIES SPECIFIED BY THE USER, IS OPTION-DEPENDENT. THE TWO BASIC TYPES OF GENERALIZED FORCE PRINTOUT ARE DESCRIBED BELOW.

1. FOR K OR P-K SOLUTION, USING GENERALIZED AIR FORCE INTERPOLATION, THE COMPUTED AND INTERPOLATED GENERALIZED FORCE MATRICES MAY BE DISPLAYED FOR EACH OF THE REDUCED FREQUENCIES SELECTED AS A BASE SET (MAXIMUM OF 6). THESE MATRICES ARE DISPLAYED IN THE ORDER IN WHICH THE INTERPOLATION TEST PROCEEDS.
2. FOR K SOLUTION, USING GENERALIZED AERODYNAMIC FORCE INTERPOLATION, THE INTERPOLATED FORCE MATRICES MAY ALSO BE DISPLAYED FOR EVERY REDUCED FREQUENCY FOR WHICH A FLUTTER SOLUTION IS REQUIRED (MAXIMUM OF 30).

THE GENERALIZED FORCES, AS PRESENTED, MUST BE MULTIPLIED BY -W**2 (W IS ANGULAR FREQUENCY). THIS DATA MAY BE DISPLAYED FOR THE DOUBLET LATTICE METHOD, IN ADDITION TO ITEM 8(B) ABOVE.

ITEM 10(E). FLUTTER SOLUTIONS

SOLUTIONS TO THE FLUTTER EQUATION USING THE K METHOD TABULATED IN ORDER OF ASCENDING FREQUENCY, FOR EACH VALUE OF REDUCED VELOCITY (DENOTED AS 'VBC' IN THE PRINTOUT). SINCE ROOTS ARE NOT IDENTIFIED OR TRACED WHEN USING THE K SOLUTION PROCEDURE, THE USER MUST REFER TO THE RESULTS FOR EACH REDUCED VELOCITY IN ORDER TO TRACE A PARTICULAR ROOT. PRINT PLOTS OF THE FLUTTER SOLUTIONS, WHICH FOLLOW THE TABULATED RESULTS, ARE HELPFUL IN PERFORMING THIS TASK.

ITEM 11(F). FLUTTER SOLUTIONS

WHEN USING THE P-K SOLUTION PROCEDURE, DAMPING AND FREQUENCY OF THE ROOTS OF THE FLUTTER EQUATION ARE TABULATED VERSUS VELOCITY. A ROOT ORDERING AND ROOT TRACING PROCEDURE SHOWS THE RESULTS FOR EACH ROOT (MODE) IN A SEPARATE TABLE. THE USER SHOULD BE CAUTIONED, HOWEVER, THAT THE ROOT ORDERING IS NOT ALWAYS RELIABLE EVEN THOUGH THE VALUES OF THE ROOTS ARE CORRECT. EXAMINATION OF EACH TABLE WILL INDICATE WHERE AN ERRONEOUS ROOT IDENTIFICATION OCCURRED.

IF THE USER DOES NOT REQUEST ANY ADDITIONAL CLUE-DEPENDENT OUTPUT PERTAINING TO FLUTTER REDESIGN (ITEM 12(F) BELOW), THEN THE AFAM OUTPUT TERMINATES WITH A PRINTOUT SPECIFYING THE VELOCITY, DAMPING (VERY CLOSE TO ZERO) AND FREQUENCY OF THE LOWEST FLUTTER SPEED INSTABILITY PLUS PRINT-PLOTS OF ALL FLUTTER SOLUTIONS. THE PRINT-PLOTS ARE FOR FREQUENCY AND DAMPING VERSUS AIRSPEED, AND FREQUENCY VERSUS DAMPING.

ITEM 12(F). EIGENVECTORS AND AERODYNAMIC FORCE GRADIENTS NEEDED FOR FLUTTER REDESIGN.

THIS IS OPTIONAL OUTPUT, REQUIRED WHEN FLUTTER REDESIGN IS TO BE ACCOMPLISHED.

THE FIRST OUTPUT IS THE INTERPOLATED GENERALIZED AERODYNAMIC FORCE MATRIX AT THE PRECISE FLUTTER CONDITION. THE 'COL VECTOR' AND 'ROW VECTOR' ARE THE COMPLEX FLUTTER VECTOR AND ITS ASSOCIATED ROW VECTOR IN MODAL COORDINATES. THIS DATA APPEARS TWICE, WHERE THE SECOND PRINTOUT REFLECTS A NORMALIZATION OF THE ROW VECTOR SUCH THAT VTRAN*(M+QBAR)*U=1.0. WITH THIS NORMALIZATION, IT CAN BE SHOWN THAT VTRAN*K*U=WF**2 WHERE WF IS THE ANGULAR FLUTTER FREQUENCY. TO CHECK THE ACCURACY OF THE COMPUTED VECTORS, THE PROGRAM LISTS WF**2 AS 'ROOT FOR RUDISILL OPTIMIZATION', AND ALSO THE RESULTS OF THE OPERATION VTRAN*K*U. THE LATTER RESULT SHOULD HAVE A REAL VALUE EQUAL TO WF**2 AND AN IMAGINARY VALUE VERY CLOSE TO ZERO. THE 'GRADIENT OF GENERALIZED AERODYNAMIC FORCES' IS THE DERIVATIVE OF THE GENERALIZED FORCE MATRIX WITH RESPECT TO REDUCED FREQUENCY AT THE FLUTTER CONDITION.

AFOM - AUTOMATED FLUTTER OPTIMIZATION MODULE

IF FOP IS SIMPLY BEING USED TO COMPUTE FLUTTER VELOCITY DERIVATIVES WITHOUT PERFORMING FLUTTER REDESIGN, AFOM IS ENTERED ONLY ONCE. IN THIS CASE, ITEMS 2,4 AND 5 OF THE FOLLOWING MATERIAL ARE THE ONLY ITEMS THAT MAY APPEAR IN THE OUTPUT.

WHEN FLUTTER REDESIGN IS TO BE PERFORMED, AFOM WILL BE ENTERED MORE THAN ONCE. ITEMS 1 AND 2 MAY THEN APPEAR IN THE FIRST ENTRY ONLY, BUT THE REMAINING EIGHT ITEMS MAY APPEAR IN ALL ENTRIES.

SUMMARY OF OUTPUT ITEMS FOR AFOM

1. FLUTTER OPTIMIZATION PARAMETERS
2. TRANSFORMATION MATRICES QT AND QAT
3. CONVERGENCE OF THE REDESIGN PROCEDURE (COUPLED MODES)
4. FLUTTER VECTORS IN STRUCTURAL COORDINATES
5. FLUTTER VELOCITY DERIVATIVES
6. DESIGN ITERATIONS TO ACHIEVE DESIRED FLUTTER SPEED STEP SIZE
7. WEIGHT SUMMARY
8. REDESIGN DETAILS
9. INCREMENTAL MASS AND STIFFNESS MATRICES IN STRUCTURAL COORDINATES
10. MODAL MASS AND MODAL STIFFNESS MATRICES

THESE OUTPUT ITEMS ARE DISCUSSED IN THE FOLLOWING MATERIAL.

ITEM 1. FLUTTER OPTIMIZATION PARAMETERS

IN A FLUTTER REDESIGN RUN, THOSE FLUTTER OPTIMIZATION PARAMETERS WHICH DEPEND ON INPUT DATA ARE LISTED THE FIRST TIME AFOM IS ENTERED. THESE PARAMETERS INCLUDE THE REQUIRED FLUTTER SPEED, LIMITS OF THE FLUTTER BAND, CONVERGENCE CRITERION, ETC.

ITEM 2. TRANSFORMATION MATRICES QT AND QAT

TRANSFORMATION MATRICES QT AND (POSSIBLY) QAT CAN BE LISTED AS OPTIONAL OUTPUT THE FIRST TIME AFOM IS ENTERED. THE ROWS OF THESE MATRICES CONTAIN THE VIBRATION MODE SHAPES AS EXPRESSED IN THE STRUCTURES MODEL. IF A FREE-FREE VIBRATION ANALYSIS WAS PERFORMED IN AVAM, THE MODES IN QT ARE IN RELATIVE COORDINATES WHILE THOSE IN QAT ARE IN ABSOLUTE COORDINATES. IN THE CASE OF A CANTILEVER VIBRATION ANALYSIS, QT CONTAINS ABSOLUTE MODE SHAPES, AND QAT DOES NOT EXIST.

ITEM 3. CONVERGENCE OF THE REDESIGN PROCEDURE (COUPLED MODES)

IN A FLUTTER REDESIGN RUN, AFOM ALWAYS LISTS THE CURRENT FLUTTER SPEED AND INDICATES WHETHER OR NOT THAT SPEED FALLS WITHIN THE FLUTTER BAND. IF IT IS WITHIN THE BAND, THE NUMBER OF CONSECUTIVE LANDINGS IN THE BAND (DURING THIS FOP RUN ONLY) IS INDICATED BY MEANS OF VARIABLE 'IBAND'. THEN, IF 'IBAND' IS LARGER THAN ONE, THE WEIGHT CHANGE IN THE LAST FLUTTER REDESIGN IS GIVEN. AND A MESSAGE IS PROVIDED IF THE CONVERGENCE CRITERION IS SATISFIED.

ITEM 4. FLUTTER VECTORS IN STRUCTURAL COORDINATES

THE FLUTTER VECTOR 'U' AND THE ASSOCIATED VECTOR 'V' NEEDED IN THE FLUTTER VELOCITY DERIVATIVE COMPUTATIONS CAN BE LISTED IN STRUCTURAL COORDINATES AS OPTIONAL OUTPUT. THESE VECTORS ARE COMPLEX. IF FREE-FREE VIBRATION MODES WERE USED IN THE FLUTTER ANALYSIS, THE 'U' AND 'V' VECTORS ARE LISTED IN BOTH RELATIVE COORDINATES (FOR STRAIN ENERGY DENSITY COMPUTATIONS) AND ABSOLUTE COORDINATES (FOR KINETIC ENERGY DENSITY COMPUTATIONS).

ITEM 5. FLUTTER VELOCITY DERIVATIVES

FLUTTER VELOCITY DERIVATIVES, STRAIN ENERGY DENSITIES, AND KINETIC ENERGY DENSITIES ARE LISTED FOR STRUCTURAL MEMBERS AND MASS BALANCES (IF ANY) EACH TIME AFOM IS ENTERED. IN THE FIRST ENTRY, THESE QUANTITIES ARE BASED ON THE RESULTS OF A NORMAL MODE FLUTTER ANALYSIS. FOR SUBSEQUENT ENTRIES, COUPLED MODE RESULTS ARE ALWAYS USED. WHEN FLUTTER REDESIGN IS BEING PERFORMED IN FOP, THE DERIVATIVES AND ENERGY DENSITIES ARE NOT PRESENTED FOR THOSE STRUCTURAL MEMBERS WHICH THE USER HAD PERMANENTLY EXCLUDED FROM THE FLUTTER REDESIGN PROCESS. THESE QUANTITIES ARE, HOWEVER, PRESENTED FOR ALL STRUCTURAL MEMBERS AND MASS BALANCES WHEN FOP IS CALLED UPON TO COMPUTE FLUTTER VELOCITY DERIVATIVES WITHOUT RESIZING FOR FLUTTER.

IF FLUTTER RESIZING HAS PREVIOUSLY OCCURRED IN THE CURRENT FOP PASS, THE PROGRAM WILL ALSO PROVIDE A SEPARATE LIST OF DERIVATIVES FOR THE VARIABLES WHICH HAD BEEN CLASSIFIED AS FLUTTER-CRITICAL IN THE LAST RESIZING. BOTH OLD DERIVATIVES (BEFORE THE REDESIGN) AND NEW DERIVATIVES (AFTER THE REDESIGN) ARE PRESENTED. MEAN VALUES AND STANDARD DEVIATIONS ARE ALSO GIVEN FOR THESE TWO GROUPS OF DERIVATIVES. FINALLY, IF NO FURTHER FLUTTER RESIZING IS TO BE ACCOMPLISHED IN THE RUN, THE PROGRAM WILL LIST THE STRUCTURAL MEMBERS WHICH WERE FLUTTER-CRITICAL IN THE LAST RESIZING.

ITEM 6. DESIGN ITERATIONS TO ACHIEVE DESIRED FLUTTER SPEED STEP SIZE

WHEN A FLUTTER REDESIGN IS TO BE ACCOMPLISHED, THE PROGRAM FIRST LISTS THE DESIRED FLUTTER SPEED STEP SIZE AND THEN INDICATES LOWER AND UPPER LIMITS FOR AN ACCEPTABLE (LINEARLY PREDICTED) STEP SIZE. THE PROGRAM WILL THEN NORMALLY HAVE TO PERFORM A SERIES OF TRIAL REDESIGNS BEFORE AN ACCEPTABLE STEP SIZE IS ACHIEVED. FOR EACH TRIAL REDESIGN, THE FOLLOWING FOUR QUANTITIES ARE LISTED.

1. TRIAL NUMBER
2. TARGET DERIVATIVE USED IN THE TRIAL
3. LINEARLY PREDICTED STEP SIZE FOR THE TRIAL
4. WEIGHT CHANGE ASSOCIATED WITH THE TRIAL

THIS ITERATIVE PROCESS CONTINUES UNTIL AN ACCEPTABLE STEP SIZE IS ACHIEVED OR UNTIL IT IS CONCLUDED THAT AN ACCEPTABLE STEP CANNOT BE ACHIEVED. IN EITHER CASE, AN APPROPRIATE MESSAGE APPEARS AND THE REDESIGN ASSOCIATED WITH THE LAST TRIAL IS ACCEPTED.

ITEM 7. WEIGHT SUMMARY

WHEN A FLUTTER REDESIGN HAS BEEN ACCEPTED, THE PROGRAM

PROVIDES A SUMMARY OF WEIGHTS. HERE, THE WEIGHT CHANGE ASSOCIATED WITH THE LAST REDESIGN IS BROKEN DOWN INTO A CONTRIBUTION FROM STRUCTURAL MEMBERS AND A CONTRIBUTION FROM MASS BALANCE VARIABLES. A SIMILAR BREAKDOWN IS THEN GIVEN FOR THE CUMULATIVE REDESIGN FROM THE START OF THE ENTIRE STRENGTH-FLUTTER RESIZING PROCESS (EXCLUDING THE INITIAL SOP PASS) TO THE CURRENT DESIGN.

ITEM 8. REDESIGN DETAILS

THE DETAILS OF THE CURRENT REDESIGN ARE ALWAYS LISTED AND ARE SEPARATED INTO TWO DISTINCT CATEGORIES, NAMELY FLUTTER-CRITICAL ELEMENTS AND NON-CRITICAL ELEMENTS. A FLUTTER-CRITICAL ELEMENT IS ONE THAT WAS RESIZED BY THE FLUTTER RESIZING ALGORITHM WITHOUT ENCOUNTERING A MINIMUM MANUFACTURING CONSTRAINT OR A STRESS CONSTRAINT. AN ELEMENT THAT WAS LIMITED BY EITHER OF THESE CONSTRAINTS IS NON-CRITICAL. NOTE THAT THIS DEFINITION IMPLIES THAT MASS BALANCE VARIABLES ARE ALWAYS FLUTTER-CRITICAL.

THE FOLLOWING EIGHT QUANTITIES ARE LISTED FOR EACH STRUCTURAL MEMBER IN BOTH CATEGORIES.

1. MEMBER - IDENTIFICATION NUMBER OF THE ELEMENT

2. DERIVATIVE - FLUTTER VELOCITY DERIVATIVE BEFORE CURRENT RESIZING

3. OLD GAGE - GAGE BEFORE CURRENT RESIZING

4. NEW GAGE - GAGE AFTER CURRENT RESIZING

5. DELTA W - WEIGHT CHANGE DUE TO CURRENT RESIZING

6. DELTA V - LINEARLY PREDICTED CHANGE IN FLUTTER SPEED DUE TO CURRENT RESIZING OF THIS MEMBER. THIS IS SIMPLY THE PRODUCT OF THE DERIVATIVE AND THE WEIGHT CHANGE.

7. DELTA W (CUM) - CUMULATIVE WEIGHT CHANGE OF THIS MEMBER DUE TO ALL STRENGTH-FLUTTER RESIZING BEYOND THE INITIAL SOP PASS. THAT IS, IT IS THE DIFFERENCE BEWEEN THE CURRENT WEIGHT OF THE MEMBER AND THE WEIGHT AS IT ENTERED THE FIRST FOP PASS.

8. CONSTRAINT - TYPE OF CONSTRAINT ENCOUNTERED (IF ANY) WHEN MEMBER WAS RESIZED. A FLUTTER-CRITICAL ELEMENT MAY BE CONSTRAINED BY A MAXIMUM-CUT PARAMETER OR BY A MAXIMUM ALLOWABLE GAGE. A NON-CRITICAL ELEMENT MUST HAVE ENCOUNTERED A MINIMUM MANUFACTURING GAGE CONSTRAINT OR A STRESS CONSTRAINT.

THE REDESIGN DETAILS OF A MASS BALANCE VARIABLE ARE SIMILAR

TO THOSE OF A STRUCTURAL MEMBER (AS DISCUSSED ABOVE) EXCEPT THAT THE 'OLD GAGE' AND 'NEW GAGE' ARE REPLACED BY 'OLD W' AND 'NEW W'. THAT IS, WEIGHTS ARE USED RATHER THAN GAGES. ALSO, NOTE THAT A MASS BALANCE VARIABLE CAN ONLY BE CONSTRAINED BY A MAXIMUM-CUT PARAMETER.

AT THE END OF EACH CATEGORY (FLUTTER-CRITICAL OR NON-CRITICAL) THE PROGRAM SUMMARIZES THE CATEGORY BY LISTING THE FOLLOWING INFORMATION.

A) NUMBER OF ELEMENTS IN THE CATEGORY
B) NUMBER OF ELEMENTS CONSTRAINED BY EACH OF THE POSSIBLE CONSTRAINTS ASSOCIATED WITH THE CATEGORY
C) TOTAL WEIGHT CHANGE DUE TO CURRENT RESIZING OF ALL ELEMENTS IN THE CATEGORY
D) LINEARLY PREDICTED CHANGE IN FLUTTER VELOCITY DUE TO CURRENT RESIZING OF ALL ELEMENTS IN THE CATEGORY

ITEM 9. INCREMENTAL MASS AND STIFFNESS MATRICES IN STRUCTURAL COORDINATES

AS OPTIONAL OUTPUT, THE PROGRAM CAN LIST BOTH THE INCREMENTAL MASS AND INCREMENTAL STIFFNESS MATRICES IN STRUCTURAL COORDINATES. NOTE THAT THESE INCREMENTAL MATRICES ARE ASSOCIATED WITH THE CURRENT REDESIGN ONLY. THAT IS, THEY ARE NOT CUMULATIVE.

ITEM 10. MODAL MASS AND MODAL STIFFNESS MATRICES

THE PROGRAM CAN LIST THE FOLLOWING FOUR MODAL MATRICES AS OPTIONAL OUTPUT.

A. MODAL MASS BEFORE LATEST REDESIGN
B. INCREMENTAL MODAL MASS ASSOCIATED WITH LATEST REDESIGN
C. MODAL STIFFNESS BEFORE LATEST REDESIGN
D. INCREMENTAL MODAL STIFFNESS ASSOCIATED WITH LATEST REDESIGN

THE FOLLOWING TWO MODAL MATRICES ARE ALWAYS LISTED.

E. UPDATED MODAL MASS (SUM OF MATRICES A AND B ABOVE)
F. UPDATED MODAL STIFFNESS (SUM OF MATRICES C AND D ABOVE)

PART D

PROGRAM EXECUTION

SPECIFIC INPUT DATA REQUIREMENTS FOR FIRST AND SUBSEQUENT PASSES THROUGH SOP

THE OVERVIEW OF FASTOP AND SOP GIVEN IN PART A FOCUSES ON THE USE OF FASTOP FOR INTERACTIVE STRENGTH FLUTTER REDESIGN. IT IS NOTED THEREIN, THAT AN INITIAL PASS THROUGH SOP REQUIRES EXECUTION OF THE LOADS AND TRANSFORMATION MODULES IN ADDITION TO THE STRENGTH MODULE. SINCE IN THE INITIAL PASS, A LARGE AMOUNT OF DATA, INCLUDING DESIGN LOAD CONDITIONS, ARE SAVED ON STORAGE UNITS, IT FOLLOWS THAT SOP INPUT DATA FOR SECOND AND SUBSEQUENT PASSES ARE SIGNIFICANTLY REDUCED. A DETAILED DESCRIPTION OF CARD INPUT DATA FOR SOP IS GIVEN IN PART B. THE PURPOSE OF THIS PART (PART D) OF THE USER'S MANUAL IS TO PROVIDE AN OVERVIEW OF INPUT DATA REQUIRED FOR A FIRST AND SECOND (OR SUBSEQUENT) PASS THROUGH SOP, WITH PARTICULAR EMPHASIS ON THOSE CHANGES TO INPUT DATA THAT MUST BE ACCOMPLISHED BETWEEN THE T*O. THUS IN THE DISCUSSION OF CHANGES TO CLUE WORDS, IT WILL BE RECOGNIZED THAT MANY CLUE WORDS, WHICH HAVE NO EFFECT ON THE ACTUAL FUNCTIONS PERFORMED BY SOP, HAVE BEEN OMITTED.

I. SOP (MAIN PROGRAM) OPTIONS AND DATA

CARD INPUT DATA FOR SOP ARE DESCRIBED IN CORRESPONDING INPUT SECTION IN PART B. THE CLUES NEEDED FOR AN OPTIMIZATION RUN, USING THE FLEXIBILITY APPROACH IN EITHER A FIRST OR SUBSEQUENT EXECUTION, ARE SUMMARIZED IN TABLE 1. IN THIS EXAMPLE STRENGTH REDESIGN IS BEING ACCOMPLISHED IN SUBSEQUENT CYCLES. IF ONLY A REVISED FLEXIBILITY MATRIX WAS REQUIRED IN A SUBSEQUENT CYCLE, THEN KLUE(6) WOULD BE ZERO FOR THAT CYCLE. ALSO, THIS EXAMPLE ANTICIPATES THAT A FREE-FREE VIBRATION ANALYSIS IS TO BE PERFORMED IN FOP.

II. ALAM OPTIONS AND DATA

CARD INPUT DATA FOR ALAM ARE DESCRIBED IN CORRESPONDING INPUT SECTION IN PART B. CLUES ARE DESCRIBED IN ITEM 3.

IN EXECUTING THIS MODULE CARE SHOULD BE TAKEN IN SELECTING THE LOAD CONDITIONS WHICH BECOME INPUT TO ASAM. THE NUMBER OF FLIGHT CONDITIONS (NFC - EITHER ITEM 22 OR 37 IN ALAM) PLUS THE LOAD CONDITION FROM CARDS (SEE LABEL CARD DESCRIPTION - ITEM 25, IN ASAM) MUST BE EQUAL TO OR LESS THAN EIGHT (NLC - ITEM 5, IN

ASAM).

III. ASAM/ASOM OPTIONS AND DATA

CARD INPUT DATA FOR ASAM/ASOM ARE DESCRIBED IN CORRESPONDING INPUT SECTION IN PART B. THE CLUES NEEDED FOR AN OPTIMIZATION RUN, USING THE FLEXIBILITY APPROACH IN EITHER A FIRST OR SUBSEQUENT EXECUTION, ARE SUMMARIZED IN TABLE 2. IN ADDITION APPROPRIATE CLUES ARE ALSO INCLUDED TO INDICATE COMMUNICATION FROM SOP TO FOP AND FROM FOP TO SOP. MOREOVER, CLUES ARE INCLUDED TO INDICATE THAT SYMMETRIC FREE-FREE VIBRATION ANALYSIS IS TO BE PERFORMED IN FOP.

IV. ATAM OPTIONS AND DATA

CARD INPUT DATA FOR ATAM ARE DESCRIBED IN CORRESPONDING INPUT SECTION IN PART B. CLUES ARE DESCRIBED IN ITEM 3.

IN EXECUTING THIS MODULE THE STRUCTURES GRID GEOMETRY (ENTERED AS DATA IN ITEM 6) SHOULD BE CONSISTENT WITH THE STRUCTURES GEOMETRY ENTERED AS DATA IN ASAM/ASOM (ITEM 14).

V. SUMMARY OF INPUT DATA, OTHER THAN MAIN PROGRAM CLUE WORDS, REQUIRED TO ACCOMPLISH SUBSEQUENT REDESIGN PASSES THROUGH SOP

A LARGE AMOUNT OF CARD INPUT DATA IS REQUIRED IN SOP FOR A FIRST PASS SUBMITTAL. HOWEVER, AS NOTED PREVIOUSLY, ALL DESIGN LOADS AND TRANSFORMATION MATRICES PERTINENT TO SUBSEQUENT STRENGTH ANALYSIS/REDESIGN IN ASAM/ASOM ARE SAVED IN THIS INITIAL PASS. THUS, IN ANY SUBSEQUENT PASS, THE USER SPECIFIES INPUT DATA FOR THE MAIN PROGRAM AND FOR ASAM/ASOM ONLY. SPECIFICALLY, THE DATA REQUIRED FOR ASAM/ASOM ARE AS GIVEN IN TABLE 3, WHERE THE VARIABLE 'MAXAN' WILL SPECIFY THE NUMBER OF CYCLES OF STRENGTH REDESIGN TO BE PERFORMED.

SPECIFIC INPUT DATA REQUIREMENTS FOR FIRST AND SUBSEQUENT PASSES THROUGH FOP

AN OVERVIEW OF FASTOP AND FOP IS GIVEN IN PART A OF THIS REPORT. DETAILED DESCRIPTION OF CARD INPUT DATA FOR FOP IS GIVEN IN PART C. THIS SECTION (D) PROVIDES A SUMMARY OF THE INPUT DATA FOR EXECUTING THE PROGRAM IN A FIRST AND SECOND (OR SUBSEQUENT) PASS WITH PRIMARY EMPHASIS ON THE CHANGES TO INPUT

DATA REQUIRED BETWEEN THESE TWO TYPES OF RUNS.

THUS, IN THE DISCUSSION OF CHANGES TO CLUE WORDS, IT WILL BE RECOGNIZED THAT ANY CLUE WORDS WHICH DO NOT EFFECT THE FUNCTIONS PERFORMED BY FOP HAVE BEEN OMITTED.

IT IS ASSUMED THAT ALL MODULES ARE BEING EXECUTED IN THE CURRENT RUN (WHETHER FIRST OR SUBSEQUENT PASS), THAT IS AVAM, AFAM, AND AFCM. THUS, IF THE USER WISHES TO EXECUTE AVAM ONLY HE MUST MODIFY THE DATA ACCORDINGLY.

I. FOP (MAIN PROGRAM) OPTIONS AND DATA

CARD INPUT DATA FOR FOP ARE DESCRIBED IN CORRESPONDING INPUT SECTION IN PART C. THE CLUES NEEDED FOR AN OPTIMIZATION RUN, USING THE FLEXIBILITY APPROACH IN EITHER A FIRST OR SUBSEQUENT EXECUTION, ARE SUMMARIZED IN TABLE 4.

NOTE THAT THE MAIN PROGRAM CLUES, AS INDICATED IN TABLE 4 ARE FOR A CASE WHERE THE 'FLEXIBILITY APPROACH' IS USED TO COMPUTE FREE-FREE MODES, WHERE MASS BALANCE DESIGN VARIABLES ARE INCLUDED IN THE FLUTTER REDESIGN PROCESS, AND WHERE SPECIFIED STRUCTURAL ELEMENTS ARE EXCLUDED FROM FLUTTER REDESIGN. IT IS NOTED THAT THE VALUES OF THE FOLLOWING CLUES MUST REMAIN UNCHANGED BETWEEN INITIAL AND SUBSEQUENT PASSES, EVEN THOUGH THE DATA ASSOCIATED WITH THESE CLUES ARE ONLY ENTERED IN THE INITIAL PASS. THESE CLUES ARE KLUE(28), (29), (30), (31), (35), (36), AND (37).

II. AVAM OPTIONS AND DATA

CARD INPUT DATA FOR AVAM ARE DESCRIBED IN CORRESPONDING INPUT SECTION IN PART C. CLUES ARE AS DESCRIBED IN ITEM 3.

IN EXECUTING THIS PROGRAM, CARE SHOULD BE TAKEN IN INDICATING WHETHER A 'STIFFNESS' OR A 'FLEXIBILITY APPROACH' IS TAKEN. THIS INFORMATION IS CONTROLLED BY THE CLUE KLUE(27) IN FOP.

A SUMMARY OF THE CLUES FOR AVAM IS OMITTED SINCE ONLY ONE OF THEM AFFECTS THE FUNCTIONS PERFORMED BY THIS MODULE. THIS IS KLUEV(2) WHICH IS EQUAL TO 2 WHENEVER CALCOMP PLOTS OF VIBRATION MODE SHAPES ARE REQUIRED. FOR A SECOND OR SUBSEQUENT PASS THE INPUT DATA TO AVAM ASSOCIATED WITH ITEMS 6, 8, 10, 11, 14, 15, AND 17 MUST BE ELIMINATED.

III. AFAM OPTIONS AND DATA

CARD INPUT DATA FOR AFAM ARE DESCRIBED IN CORRESPONDING

INPUT SECTION IN PART C. THE CLUES IN THIS MODULE ARE ENTERED THROUGH THE LC(I) ITEM NUMBER 4.

A SUMMARY OF THE VALUES FOR LC(I) FOR A FIRST AND SUBSEQUENT PASS IS GIVEN IN TABLE 5. THESE VALUES PERTAIN TO A FLUTTER ANALYSIS USING SUBSONIC DOUBLET-LATTICE THEORY AND THE P-K SOLUTION METHOD. IT IS NOTED THAT P-K SOLUTION IS MANDATORY FOR FLUTTER REDESIGN (LC(1) = -1). THE ONLY CHANGE TO INPUT CLUES BETWEEN A FIRST AND SUBSEQUENT PASS IS FOR LC(22), WHERE IN THE INITIAL PASS, THE AERODYNAMIC INFLUENCE COEFFICIENT MATRIX IS GENERATED AND SAVED, (LC(22) = 0), AND THE SAVED AIC MATRIX IS USED FOR SUBSEQUENT FLUTTER ANALYSIS, (LC(22) = 1). ALL OTHER AFAM INPUT DATA REMAINS UNCHANGED FROM A FIRST TO SUBSEQUENT CYCLE OF REDESIGN.

IV. AFOM OPTIONS AND DATA

CARD INPUT DATA FOR AFOM ARE DESCRIBED IN CORRESPONDING INPUT SECTION IN PART C. CLUES ARE DESCRIBED IN ITEM 4.

A SUMMARY OF THE CLUES FOR AFOM IS OMITTED SINCE NONE OF THEM AFFECT THE FUNCTIONS PERFORMED BY THIS MODULE. THE ONLY CHANGES TO AFOM INPUT DATA BETWEEN A FIRST AND A SUBSEQUENT REDESIGN CYCLE ARE FOR THOSE PARAMETERS WHICH AFFECT FLUTTER REDESIGN STEP-SIZE AND NUMBER OF REDESIGN CYCLES.

V. SUMMARY OF INPUT DATA, OTHER THAN MAIN PROGRAM CLUE WORDS, REQUIRED TO ACCOMPLISH SUBSEQUENT REDESIGN PASSES THROUGH FOP

OTHER THAN CLUE WORDS, MINIMAL CHANGES ARE REQUIRED TO THE FOP INPUT DATA DECK BETWEEN FIRST AND SUBSEQUENT PASSES. SPECIFICALLY, FOR AVAM, TABLE 6 INDICATES THE INPUT DATA WHICH SHOULD ONLY BE PROVIDED IN THE INITIAL PASS AND SHOULD BE OMITTED FOR ALL SUBSEQUENT PASSES.

ALL INPUT DATA FOR AFAM REMAINS UNCHANGED BETWEEN PASSES AND THE INPUT DATA FOR AFOM WILL BE CHANGED ONLY TO THE EXTENT THAT THE USER WISHES TO MODIFY THE FLUTTER REDESIGN STEP SIZE AND THE NUMBER OF FLUTTER REDESIGN CYCLES TO BE ACCOMPLISHED IN AFOM. FLUTTER REDESIGN IS AFFECTED BY THE FOLLOWING ITEMS.

ITEM	VARIABLE
6	VDES
7	NBAR
7	NFIX

ADDITIONAL AFOM PARAMETERS, CONTROLLING CONVERGENCE CRITERIA, MAY ALSO BE CHANGED AT ANY POINT IN THE REDESIGN PROCESS.

DISK ORIENTED SEQUENTIAL INPUT/OUTPUT (DSIO)

ORIGINALLY THIS PROCEDURE WAS DEVELOPED TO BE UTILIZED WITH IBM COMPUTERS AND WAS INTENDED TO REPLACE FORTRAN UNFORMATTED INPUT/OUTPUT FOR MORE EFFICIENT I/O CAPABILITY. ITS MAJOR FUNCTION WAS TO PROCESS DATA SETS ON DIRECT ACCESS DEVICES (DISKS) AS IF THEY WERE MULTI-FILE TAPES. HENCE THE EMPHASIS ON DISK ORIENTED SEQUENTIAL INPUT/OUTPUT. THE CDC VERSION PROVIDES COMPATIBILITY WITH THE IBM VERSION WITH THE EMPHASIS HERE BEING EFFICIENT I/O CAPABILITY. THE TWO SETS OF PROGRAMS WHICH ACCOMPLISH THIS OBJECTIVE ARE UNIQUE TO EACH COMPUTER AND ARE THEREFORE NOT INTERCHANGEABLE.

IN CDC USAGE EACH 'LOGICAL UNIT NUMBER' REFERS TO AN ORDERED SET OF SCOPE SEQUENTIAL FILES DEFINED BY THE USER (SEE SUMMARY TABLE 7). UP TO TEN LOGICAL UNIT NUMBERS FOR SOP AND EIGHT FOR FOP ARE DEFINED WITH UP TO TEN SCOPE SEQUENTIAL FILES PER SET. ONLY ONE FILE IN EACH SET MAY BE OPEN FOR PROCESSING AT ANY ONE TIME. BEAR IN MIND THAT THE FILES USED BY DSIO ARE NOT RELATED TO THOSE DEFINED ON THE PROGRAM CARD AND CANNOT BE MANIPULATED BY FORTRAN I/O STATEMENTS.

ALL DSIO FILES ARE ORDINARY SCOPE FILES AND MAY BE ASSIGNED TO TAPE OR PERMANENT FILE BY MEANS OF REQUEST, LABEL, OR ATTACH CONTROL CARDS, COPIED BY COPYBF JOB CONTROL LANGUAGE CARDS.

AS AN ILLUSTRATIVE EXAMPLE CONSIDER A FIRST PASS IN SOP WITH COMMUNICATION WITH FOP USING THE STIFFNESS APPROACH AND ANTICIPATING A CANTILEVER VIBRATION ANALYSIS IN FOP. AFTER EXECUTION OF SOP THE SOTOFO UNIT CONTAINING THREE FILES MUST BE SAVED AS INPUT TO A FIRST PASS IN FOP.

1. ELEMENT STIFFNESS (FILE FL0901)
2. MEMBER PROPERTIES (FILE FL0902)
3. STRUCTURAL STIFFNESS (FILE FL0903)

ASSUMING THAT THE INFORMATION IS SAVED ON TAPE, THE FOLLOWING SET OF JCL CARDS ARE NEEDED.

```
REQUEST,TAPE09,VSN=SCRATCH.
REWIND,FL0901,FL0902,FL0903.
COPYBF,FL0901,TAPE09.
COPYBF,FL0902,TAPE09.
COPYBF,FL0903,TAPE09.
UNLOAD,TAPE09.
```

NOTE THAT THE FILE NAME TAPE09 DOES NOT REALLY REPRESENT UNIT 9 BUT IS A SYMBOLIC NAME FOR SAVING THE INFORMATION

GENERATED AND STORED ON FILES FL0901, FL0902, AND FL0903. THE FILE NAME TAPE09 WAS USED TO RELATE THIS INFORMATION TO UNIT 9 SHOWN IN TABLE 7. THIS FILE NAME COULD HAVE BEEN UNIT09 OR ANY OTHER SEVEN OR LESS CHARACTER WORD THE USER DESIRES TO ASSIGN TO THIS UNIT. THE IMPORTANT CONSIDERATION HERE IS THAT THE FILE NAME MUST BE CONSISTENT ON THE REQUEST, COPYBF, AND UNLOAD JCL CARDS.

NOW CONSIDER THE NEXT EXECUTION WHICH IS A FIRST PASS IN FOP WHERE THE INFORMATION SAVED ON TAPE09 (SOTOFO) IS INPUT TO FOP.

PRIOR TO EXECUTING THIS PROGRAM THE FILES ON THE SOTOFO TAPE MUST BE COPIED INTO THE DSIO FILES RECOGNIZED BY THE SCOPE SYSTEM. THE PROCEDURE NOW IS THE REVERSE OF WHAT WAS DONE FOR SOP.

```
REQUEST,TAPE05.  PLEASE MOUNT REEL CXXXX.
REWIND,FL0501,FL0502,FL0503.
COPYBF,TAPE05,FL0501.
COPYBF,TAPE05,FL0502.
COPYBF,TAPE05,FL0503.
REWIND,FL0501,FL0502,FL0503.
UNLOAD,TAPE05.
```

THUS FAR THE DISCUSSION HAS CENTERED ON FIRST PASS SINGLE-STEP SUBMITTALS FOR SOP AND FOP WHERE OUTPUT FROM SOP IS USED AS INPUT IN FOP. FOR A MULTI-STEP SUBMITTAL THE USER MUST INCLUDE SIMILAR COPYING PROCEDURES IN ORDER TO RELATE THE OUTPUT FROM ONE PROGRAM TO THE INPUT OF THE OTHER PROGRAM. IN ADDITION THIS PROCEDURE IS NECESSARY TO TEMPORARILY STORE INFORMATION GENERATED IN ONE PROGRAM ON TO A TEMPORARY STORAGE DEVICE FOR USE IN LATER STEPS. THIS WILL PREVENT DESTRUCTION OF THE INFORMATION WHEN THE SAME SCOPE FILES ARE BEING USED AS SCRATCH UNITS IN SUBSEQUENT STEPS. FOR EXAMPLE IN A FOP-SOP-FOP RUN, THE FIRST FOP WILL GENERATE A NUMBER OF FILES (FL07NN) ASSOCIATED WITH A FOTOFO UNIT. NEXT, EXECUTION OF SOP WILL USE THE SAME UNIT (FILES FL07NN) AS A SCRATCH UNIT THEREFORE DESTROYING THE INFORMATION GENERATED IN A FIRST FOP PASS. THUS THE FILES GENERATED ON UNIT 7 IN FOP MUST BE COPIED ONTO A TEMPORARY STORAGE DEVICE BEFORE ENTERING SOP.

NOTE THAT APPROPRIATE REWIND OF THE PERTINENT FILES IS NECESSARY PRIOR TO INPUTTING OR OUTPUTTING OF GENERATED INFORMATION, OTHERWISE JOB WILL FAIL.

I	KLUE (I) Pass First	KLUE (I) Pass Subsequent	Description
1	1	0	Enter ALAM
2	2	2	Enter ASAM
3	3	3	Calculate flexibility matrix (1)
5	5	0	Enter ATAM
6	6	6	Enter ASOM (2)
26	26	26	Free-Free Vibration Analysis in FOP

(1) If the stiffness approach is used, then KLUE(3) will be "off" for first and subsequent passes.

(2) The variable MAXAN (item 5 in ASAM/ASOM) must have a value larger than zero when KLUE(6) = 6.

Table 1 - SOP Options for a First and Subsequent Pass

I	KLUES (I)		Description
	Pass		
	First	Subsequent	
1	1	1	FSD Algorithm
7*	0	0	Do Not Save Stiffness Matrix
8*	8	8	Save Flexibility Matrix
9	9	0	Load Cases From Cards
10	10	0	Load Cases From ALAM
13	0	0	Enter ASAM, Perform Strength Redesign and Calculate Flexibility Matrix
14*	14	14	Save Element Stiffnesses
15*	15	15	Save Member Properties
16*	16	16	Save Structural Displacement/Dynamic Load Transformation Matrix
17	0	17	Second or Subsequent Pass Through SOP
18	0	18	Communication From FOP to SOP. Input Member Properties
19	19	19	Symmetric Free-Free Vibration Analysis in FOP
20	0	0	Ignore Lateral Motion of Plug
21	0	0	Ignore Roll Motion of Plug
22	0	0	Ignore Yaw Motion of Plug
23	23	23	Include Fore-Aft Motion of Plug
24	24	24	Include Vertical Motion of Plug
25	25	25	Include Pitch Motion of Plug

*Associated also with the major option of "Communication from SOP to FOP."

NOTE: If the stiffness approach is used, KLUES(7) should be "on," and KLUES(8) and KLUES(16) "off".

Table 2 - ASAM Options for a First and Subsequent Pass

FASTOP – EXECUTION

Item	Data
1	SA00
2	TSH(L), L = 1, 16
3	KLUES(I), I = 1, 25
4	NUMEMB
5	MAXAN, MAXAN1 = 0, NLC
6	Logic Item No Data
7	CONCR
8	TENS(I), I = 1, NLC
9	COMP(I), I = 1, NLC
10	SHEAR(I), I = 1, NLC
38	LABEL(0), ENDSARUN

NOTE: Item numbers above correspond to the item numbers in the card input data description.

Table 3 - SOP Input Data for a Subsequent Pass

I	KLUE (I) Pass First	KLUE (I) Pass Subsequent	Description
3	3	3	Enter AVAM
4	4	4	Enter AFAM
7	7	7	Enter AFOM
26	0	26	Initial Pass/Subsequent Pass
27	27	27	Flexibility Matrix Used for Vibration Analysis
28	0	0	Initial Dynamic Mass Matrix Provided by the User
29	0	0	No Fixed Mass Items
30	0	0	No Off-Diagonal Fixed Mass Items
31	31	31	Include Mass Balance Varables
32	0	0	Do Not Supersede Existing Mass Balance
33	33	33	Strength Analysis or Redesign in Last SOP Step
34	34	34	Flutter Redesign
35	0	0	No Non-Optimum Factors
36	36	36	Exclusion of Flutter Redesign Variables
37	37	37	Free-Free Vibration Analysis

Table 4 - FOP Options for a First and Subsequent Pass

I	LC(I)		I	LC(I)	
	Pass			Pass	
	First	Subsequent		First	Subsequent
1	−1	−1	19	1	1
2	6	6	20	0	0
3	1	1	21	1	1
4	6	6	22	0	1*
5	1	1	23	1	1
6	0	0	24	1	1
7	0	0	25	0	0
8	0	0	26	0	0
9	0	0	27	0	0
10	0	0	28	0	0
11	1	1	29	0	0
12	0	0	30	0	0
13	1	1	31	0	0
14	0	0	32	0	0
15	0	0	33	0	0
16	0	0	34	0	0
17	1	1	35	0	0
18	0	0	36	1	1

*Saved AIC's are input

Table 5 - AFAM Options for a First and Subsequent Pass

Data Description	Value of Clue Which Requires that Data Item be Provided Only in Initial Pass	AVAM Item Number
Exclusion of Specified Elements from Flutter Redesign	KLUE(36) = 36	6
Specification of Element Non-Optimum Weight Factors	KLUE(35) = 35	6
Total Initial Weight of Structure	KLUE(28) = 0	10
Dynamic Mass Matrix	KLUE(28) = 0	11
Total Weight of Fixed Mass Additions	KLUE(29) = 29	14
Fixed Mass Matrix Additions	KLUE(29) = 29	15
Initial Mass Balance Data	KLUE(31) = 31	8
Plug Mass Matrix	KLUE(37) = 37	17

Table 6 - AVAM Data Required in Initial Pass Only

Unit	SOP		FOP	
	Function	DSIO or Scope File Names	Function	DSIO or Scope File Names
1	SOTOSO (1)	FL01NN*	SCRATCH	FL01NN*
2	SCRATCH	FL02NN	SCRATCH	FL02NN
3	SCRATCH	FL03NN	SCRATCH	FL03NN
4	SCRATCH	FL04NN	SCRATCH	FL04NN
5	SCRATCH	FL05NN	SOTOFO (3)	FL05NN
6	SCRATCH	FL06NN	FOTOSO (1)	FL06NN
7	SCRATCH	FL07NN	FOTOFO (1)	FL07NN
8	SOTOSO (2)	FL08NN	FOTOFO (2)	FL08NN
9	SOTOFO (1)	FL09NN	Not Used	–
10	FOTOSO (2)	FL10NN	Not Used	–

(1) Saved output in any pass
(2) Input in a subsequent pass
(3) Input in any pass

*In all logical unit numbers, NN varies from 01 to 10 representing the ten available scope files associated with the particular unit.

Table 7 - Summary of Functions of Each DSIO Unit in SOP and FOP

DEFINITION OF MAJOR SOP-FOP ANALYSIS AND OPTIMIZATION OPTIONS

PREVIOUS SECTIONS SUMMARIZE THE IMPORTANT CONTROL WORD OPTIONS NECESSARY FOR EXECUTING SOP AND FOP WITHIN FASTOP. AS A GUIDE TO THE USER, TABLES 8A AND 8B HAVE BEEN PREPARED TO DEFINE THE MOST IMPORTANT OPTIONS ASSOCIATED WITH FASTOP. A SECONDARY PURPOSE IS TO PREPARE THE APPROPRIATE SUBMITTAL SEQUENCE FOR THESE MAJOR OPTIONS. CORRESPONDING JOB CONTROL LANGUAGE SET-UPS AND APPROPRIATE INSTRUCTIONS FOR EXECUTING THE TEN OPTIONS SHOWN IN TABLE 8 ARE SHOWN IN THE NEXT SECTION.

AS CAN BE SEEN FROM TABLE 8 THERE ARE A NUMBER OF ANALYSIS AND OPTIMIZATION OPTIONS SUBDIVIDED INTO A FIRST PASS, CONSISTING PRIMARILY OF CARD INPUT DATA, AND SECOND OR SUBSEQUENT PASSES, CONSISTING OF TAPE INPUT MATRICES GENERATED IN PREVIOUS PASSES AS WELL AS CARD INPUT DATA. THE NEXT TWO IMPORTANT OPTIONS ARE COMMUNICATION BETWEEN FOP AND SOP AND BETWEEN SOP AND FOP. THESE TWO OPTIONS INDICATE WHETHER A REDESIGN CYCLE IS FOR STRENGTH OR FLUTTER. THE REMAINING TWO OPTIONS, EITHER STIFFNESS OR FLEXIBILITY APPROACH, DEAL WITH THE NON-REDUCED OR THE REDUCED DEGREES OF FREEDOM FOR THE DYNAMICS MODEL, RESPECTIVELY.

Option	Pass	Perform Load Analysis	Perform Transformation Analysis	Perform Stress Analysis or Strength Redesign	Calculate Stiffness (ST) or Flexibility (FL) for Vibration Analysis	Input From FOP (FOTOSO)	Output To FOP (SOTOFO)
1	1st	Yes	Yes	Yes	No	No	No
2	1st	Yes	Yes	Yes	ST or FL	No	Yes
3	1st	No	No	No	ST	No	Yes
4	1st	No	Yes	No	FL	No	Yes
5	2nd or subsequent	No	No	Yes	No	No	No
6	2nd or subsequent	No	No	Yes or No	ST or FL	Yes	Yes

Table 8A - Summary of Major SOP Options

Option	Pass	Perform Vibration Analysis	Perform Flutter Analysis	Perform Flutter Redesign	Vibration Analysis uses Stiffness (ST) or Flexibility (FL) Matrix	Input From SOP (SOTOFO)	Output To SOP (FOTOSO)
7	Any	Yes	No	No	ST or FL	Yes	No
8	Any	No	Yes	No	Not Applicable	No	No
9	Any	Yes	Yes	No	St or FL	Yes	No
10	Any	Yes	Yes	Yes	ST or FL	Yes	Yes

Table 8B - Summary of Major FOP Options

SUBMITTAL SEQUENCE OF MAJOR SCP-FOP ANALYSIS AND OPTIMIZATION OPTIONS

I. ARRANGEMENT OF JOB CONTROL LANGUAGE SEQUENCE

A LISTING OF THE SUBMITTAL SEQUENCE AND JOB CONTROL LANGUAGE FOR THE VARIOUS OPTIONS IS PROVIDED ON SUBSEQUENT PAGES. CERTAIN INFORMATION MUST BE PROVIDED BY THE USER FOR EXECUTING THESE OPTIONS WHEREAS OTHER INFORMATION CONTAINED WITHIN ASTERISKS AND DOTTED LINES MUST BE DELETED AND/OR REPLACED BY THE USER. SPECIFICALLY THE GROUPING OF THE INFORMATION IS AS FOLLOWS.

- COLUMN NUMBERS AT THE TOP AND BOTTOM OF EACH PAGE SHOULD BE DELETED.
- INFORMATION CONTAINED WITHIN ASTERISKS, SUCH AS THE HEADINGS FOR INFORMATION THAT FOLLOWS, IS PROVIDED AS A GUIDE FOR PREPARING THE JCL AND SHOULD BE DELETED FROM AN EXECUTABLE JCL SETUP.
- INFORMATION CONTAINED WITHIN DOTTED LINES MUST BE REPLACED BY THE USER WITH THE APPROPRIATE DATA.
- REMAINING INFORMATION SHOULD BE USED AS SHOWN.
- BLANK LINES DO NOT REPRESENT BLANK CARDS.

A BRIEF EXPLANATION OF THE TYPE OF INFORMATION INCLUDED IN A JCL SETUP FOLLOWS.

A. ACCOUNTING INFORMATION

JOB CARD PROVIDES SUCH INFORMATION AS EXECUTION TIME, NUMBER OF TAPE DRIVES, AND OTHER PERTINENT ACCOUNTING DATA.

B. SPECIAL INSTRUCTIONS

SPECIAL INSTRUCTIONS PROVIDE INFORMATION TO THE COMPUTER OPERATOR ABOUT THE USER AND THE DISPOSITION OF THE INPUT/OUTPUT TAPES. THIS INFORMATION MAY BE PROVIDED ON CARDS OR AS A SEPARATE SET OF WRITTEN INSTRUCTIONS. THE METHOD WOULD DEPEND ON THE INSTALLATION.

C. JOB CONTROL LANGUAGE

JOB CONTROL LANGUAGE CARDS ARE TO BE PREPARED AS SHOWN EXCEPT FOR THE INFORMATION CONTAINED WITHIN THE DOTTED LINES. THE LATTER INFORMATION IS DESCRIBED BY FOOTNOTES AT THE END OF EACH

LISTING.

INFORMATION ENCLOSED WITHIN SOLID LINES REPRESENTS THE JCL IN AN UPDATE FORMAT FOR UPDATING AND EXECUTING THE PROGRAMS AND DATA CASES WHICH ARE ASSUMED TO BE ON INPUT UNITS. IN A PRODUCTION RUN WHERE THE PROGRAM AND DATA CASES MAY BE STORED IN A USER'S LIBRARY, THE JCL CARDS WILL BE REDUCED TO A MINIMUM FOR PROGRAM EXECUTION.

NOTE THAT ALL JCL MUST BE IN 026 PUNCH.

D. FOOTNOTES

FOOTNOTES PROVIDE EXPLANATIONS AND INSTRUCTIONS TO THE USER. THE FOLLOWING FOOTNOTES ARE APPLICABLE TO ALL OPTIONS.

```
......
. 1A . VOLUME SERIAL NUMBER ASSOCIATED WITH THE OLD PROGRAM
...... LIBRARY WHOSE FILE LABEL NAME IS FASTOP.XXX.JULY75.
       WHERE XXX IN THE FILE LABEL NAME IS REPLACED BY THE WORD
       SOP OR FOP DEPENDING ON WHICH PROGRAM IS BEING EXECUTED.

......
. 1B . VOLUME SERIAL NUMBER ASSOCIATED WITH THE OLD DATA
...... LIBRARY WHOSE FILE LABEL NAME IS FASTOP.DATA.JULY75.

......
. EOR. REPLACE EOR BY 7-8-9 MULTIPUNCH IN COLUMN ONE.
...... IF CARDS WHICH FOLLOW EOR CARD ARE IN EBCDIC
       (029 CHARACTERS) PUNCH 29 IN COLUMNS 79 AND 80 OF THE
       EOR CARD.

......
. EOF. REPLACE EOF BY 6-7-8-9 MULTIPUNCH IN COLUMN ONE.
......
```

II. LISTING OF JOB CONTROL LANGUAGE SEQUENCE FOR MAJOR ANALYSIS AND OPTIMIZATION OPTIONS

THE FOLLOWING MATERIAL CONTAINS THE JOB CONTROL LANGUAGE (JCL) ASSOCIATED WITH THE TEN MOST IMPORTANT ANALYSIS AND OPTIMIZATION OPTIONS.

SOP MAJOR ANALYSIS AND OPTIMIZATION OPTIONS
OPTION 1

FIRST PASS
NO COMMUNICATION FROM FOP TO SOP
NO COMMUNICATION FROM SOP TO FOP
DO NOT GENERATE STIFFNESS OR FLEXIBILITY

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


***************************
* ACCOUNTING INFORMATION *
***************************

.......................................................................
.                                                                     .
. JOB CARD          - PROVIDED BY THE USER                            .
.                     EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING .
.                     DATA, AND OTHER PERTINENT INFORMATION           .
.                                                                     .
.......................................................................


***************************
* SPECIAL INSTRUCTIONS    *
***************************

                              ......
COMMENT. PLEASE MOUNT REEL . 1A . .  SAVE SCOPE FILE NEWTAPE.
                              ......
COMMENT. PLEASE MOUNT REEL . 1B . .  SAVE SCOPE FILE NEWDATA.
                              ......
COMMENT. SAVE SCOPE FILE TAPE01.
COMMENT. SAVE SCOPE FILE TAPE17.
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST    VOLUME
                   .....
COMMENT.    --     . A .          7          VAULT
                   .....
COMMENT.    --     . F .          7          VAULT
                   .....

***************************
* JOB CONTROL LANGUAGE    *
***************************



.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

FASTOP - EXECUTION - SOP(JCL)

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
                                                 ......
REQUEST,OLDTAPE,HI.  PLEASE MOUNT REEL . 1A . .
                                                 ......              ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
REQUEST,NEWTAPE,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE              ......
COMMENT. LABEL,NEWTAPE,W,L=$FASTOP.SOP.D75030$,M=NEWPL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.                                  ......
REQUEST,OLDDATA,HI.  PLEASE MOUNT REEL . 1B . .
                                                 ......              ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
REQUEST,NEWDATA,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE              ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.
```

```
REQUEST,TAPE17,HI.           .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE17,W,L=   . F .  ,M=UNIT17,T=999.
                             .....

LDSET,SUBST=OVERLA4-OVERLAY.
NEWLGO,INPDATA,PL=500000.

UNLOAD,TAPE17.

REQUEST,TAPE01,HI.           .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE01,W,L=   . A .  ,M=UNIT01,T=999.
REWIND,TAPE01.               .....
REWIND,FL0101,FL0102,FL0103,FL0104,FL0105.

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

COPYBF,FL0101,TAPE01.
COPYBF,FL0102,TAPE01.
COPYBF,FL0103,TAPE01.
COPYBF,FL0104,TAPE01.
COPYBF,FL0105,TAPE01.
UNLOAD,TAPE01.

EXIT.
DMP,000100,237100.
.......
. EOR .  END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
.                                                                      .
........................................................................
.     FORTRAN UPDATES                                                  .
........................................................................
.                                                                      .
.......
. EOR .  END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
.                                                                      .
........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES              .
.             IF CASE IS TO BE CHANGED BEFORE EXECUTING.               .
........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD.  END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************


.....
. A .  SCTOSC.P01.PPPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE01
.....  ---------------------------------


.....
. F .  SOP.UNIT17.PPPPPP  (FSIO - OUTPUT)  SCOPE FILE TAPE17
.....  ---------------------------------




.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

SOP MAJOR ANALYSIS AND OPTIMIZATION OPTIONS
OPTIONS 2 AND 4

FIRST PASS
NO COMMUNICATION FROM FOP TO SOP
COMMUNICATION FROM SOP TO FOP
STIFFNESS OR FLEXIBILITY APPROACH

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


***************************
* ACCOUNTING INFORMATION *
***************************

........................................................................
.                                                                      .
. JOB CARD        - PROVIDED BY THE USER                               .
.                   EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING .
.                   DATA, AND OTHER PERTINENT INFORMATION              .
.                                                                      .
........................................................................


***************************
* SPECIAL INSTRUCTIONS    *
***************************

                            ......
COMMENT. PLEASE MOUNT REEL . 1A . .  SAVE SCOPE FILE NE*TAPE.
                            ......
COMMENT. PLEASE MOUNT REEL . 1B . .  SAVE SCOPE FILE NE*DATA.
                            ......
COMMENT. SAVE SCOPE FILE TAPE01.
COMMENT. SAVE SCOPE FILE TAPE09.
COMMENT. SAVE SCOPE FILE TAPE17.
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST    VOLUME
                 .....
COMMENT.    --   . A .          7            VAULT
                 .....
COMMENT.    --   . B .          7            VAULT
                 .....
COMMENT.    --   . F .          7            VAULT
                 .....

***************************
* JOB CONTROL LANGUAGE    *
***************************



.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                                                  ......
REQUEST,OLDTAPE,HI.  PLEASE MOUNT REEL . 1A . .
                                                  ......                        ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
REQUEST,NEWTAPE,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE                  ......
COMMENT. LABEL,NEWTAPE,W,L=$FASTOP.SOP.D75030$,M=NEWPL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.                                   ......
REQUEST,OLDDATA,HI.  PLEASE MOUNT REEL . 1B . .
                                                  ......                        ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
REQUEST,NEWDATA,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE                  ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.

REQUEST,TAPE17,HI.           .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE17,W,L= . F . ,M=UNIT17,T=999.
                             .....

LDSET,SUBST=OVERLA4-OVERLAY.
NEWLGO,INPDATA,PL=500000.

UNLOAD,TAPE17.

REQUEST,TAPE01,HI.           .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE01,W,L= . A . ,M=UNIT01,T=999.
REWIND,TAPE01.               .....
REWIND,FL0101,FL0102,FL0103,FL0104,FL0105.
COPYBF,FL0101,TAPE01.

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

COPYBF,FL0102,TAPE01.
COPYBF,FL0103,TAPE01.
COPYBF,FL0104,TAPE01.
COPYBF,FL0105,TAPE01.
UNLOAD,TAPE01.

REQUEST,TAPE09,HI.            .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE09,W,L=  . B .  ,M=UNIT09,T=999.
REWIND,TAPE09.                .....
REWIND,FL0901,FL0902,FL0903,FL0904,FL0905,FL0906.
COPYBF,FL0901,TAPE09.
COPYBF,FL0902,TAPE09.
COPYBF,FL0903,TAPE09.
COPYBF,FL0904,TAPE09.
COPYBF,FL0905,TAPE09.
COPYBF,FL0906,TAPE09.
UNLOAD,TAPE09.

EXIT.
DMP,000100,237100.
.......
. EOR .  END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
........................................................................
.                                                                      .
.     FORTRAN UPDATES                                                  .
........................................................................
.                                                                      .
.......
. EOR .  END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
........................................................................
.                                                                      .
........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES              .
.             IF CASE IS TO BE CHANGED BEFORE EXECUTING.               .
........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD.  END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************


.....
. A .  SCTOSO.P01.PFPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE01
.....  ------------------------------------

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

.....
. B .   SCTOFO.P01.PPPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE09
.....   ---------------------------------

.....
. F .   SOP.UNIT17.PPPPPP  (FSIO - OUTPUT)  SCOPE FILE TAPE17
.....   --------------------------------

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

SOP MAJOR ANALYSIS AND OPTIMIZATION OPTIONS
OPTION 3

FIRST PASS
NO COMMUNICATION FROM FOP TO SOP
COMMUNICATION FROM SOP TO FOP
STIFFNESS APPROACH

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


***************************
* ACCOUNTING INFORMATION *
***************************

........................................................................
.                                                                      .
. JOB CARD        - PROVIDED BY THE USER                               .
.                   EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING .
.                   DATA, AND OTHER PERTINENT INFORMATION              .
.                                                                      .
........................................................................


***************************
* SPECIAL INSTRUCTIONS    *
***************************

                               ......
COMMENT. PLEASE MOUNT REEL . 1A . .  SAVE SCOPE FILE NEWTAPE.
                               ......
COMMENT. PLEASE MOUNT REEL . 1B . .  SAVE SCOPE FILE NEWDATA.
                               ......
COMMENT. SAVE SCOPE FILE TAPE01.
COMMENT. SAVE SCOPE FILE TAPE09.
COMMENT. SAVE SCOPE FILE TAPE17.
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST    VOLUME
                .....
COMMENT.   --   . A .          7             VAULT
                .....
COMMENT.   --   . B .          7             VAULT
                .....

***************************
* JOB CONTROL LANGUAGE    *
***************************




.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                                            ......
REQUEST,OLDTAPE,HI.   PLEASE MOUNT REEL  . 1A . .
                                            ......                   ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
REQUEST,NEWTAPE,HI.   PLEASE MOUNT SCRATCH TAPE AND SAVE             ......
COMMENT. LABEL,NEWTAPE,W,L=$FASTOP.SOP.D75030$,M=NEWPL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.                             ......
REQUEST,OLDDATA,HI.   PLEASE MOUNT REEL  . 1B . .
                                            ......                   ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
REQUEST,NEWDATA,HI.   PLEASE MOUNT SCRATCH TAPE AND SAVE             ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.
LDSET,SUBST=OVERLA4-OVERLAY.
NEWLGO,INPDATA,PL=500000.

REQUEST,TAPE01,HI.              .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE01,W,L=  . A  . ,M=UNIT01,T=999.
REWIND,TAPE01.                  .....
REWIND,FL0101,FL0102,FL0103,FL0104,FL0105.
COPYBF,FL0101,TAPE01.
COPYBF,FL0102,TAPE01.
COPYBF,FL0103,TAPE01.

COPYBF,FL0104,TAPE01.
COPYBF,FL0105,TAPE01.
UNLOAD,TAPE01.

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

FASTOP - EXECUTION - SOP(JCL)

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

REQUEST,TAPE09,HI.            .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE09,W,L=  . B .  ,M=UNIT09,T=999.
REWIND,TAPE09.                .....
REWIND,FL0901,FL0902,FL0903,FL0904,FL0905,FL0906.
COPYBF,FL0901,TAPE09.
COPYBF,FL0902,TAPE09.
COPYBF,FL0903,TAPE09.
COPYBF,FL0904,TAPE09.
COPYBF,FL0905,TAPE09.
COPYBF,FL0906,TAPE09.
UNLOAD,TAPE09.

EXIT.
DMP,000100,237100.
.......
. EOR .  END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
.........................................................................
.                                                                       .
.     FORTRAN UPDATES                                                   .
.........................................................................
.                                                                       .
.......
. EOR .  END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
.........................................................................
.                                                                       .
.........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES               .
.             IF CASE IS TO BE CHANGED BEFORE EXECUTING.                .
.........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD.  END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************


.....
. A .  SOTOSO.P01.PPPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE01
.....  --------------------------------

.....
. B .  SCTOFO.P01.PPPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE09
.....  --------------------------------


.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

SOP MAJOR ANALYSIS AND OPTIMIZATION OPTIONS
OPTION 5

SUBSEQUENT PASS
NO COMMUNICATION FROM FOP TO SOP
NO COMMUNICATION FROM SOP TO FOP
DO NOT GENERATE STIFFNESS OR FLEXIBILITY

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


***************************
* ACCOUNTING INFORMATION *
***************************

.........................................................................
.                                                                       .
. JOB CARD          PROVIDED BY THE USER                                .
.                   EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING  .
.                   DATA, AND OTHER PERTINENT INFORMATION               .
.                                                                       .
.........................................................................


***************************
* SPECIAL INSTRUCTIONS    *
***************************

                              ......
COMMENT. PLEASE MOUNT REEL  . 1A . .   SAVE SCOPE FILE NEWTAPE.
                              ......
COMMENT. PLEASE MOUNT REEL  . 1B . .   SAVE SCOPE FILE NEWDATA.
                              ......
COMMENT. PLEASE MOUNT REEL  . 2 . .
                              .....
COMMENT. SAVE SCOPE FILE TAPE01.
COMMENT. SAVE SCOPE FILE TAPE09.
COMMENT. SAVE SCOPE FILE TAPE17.
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST     VOLUME
                    .....
COMMENT.    --      . A .          7            VAULT
                    .....

***************************
* JOB CONTROL LANGUAGE    *
***************************




.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                                            ......
REQUEST,OLDTAPE,HI.  PLEASE MOUNT REEL  . 1A . .
                                            ......                   ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
REQUEST,NEWTAPE,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE              ......
COMMENT. LABEL,NEWTAPE,W,L=$FASTOP.SOP.D75030$,M=NEWPL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.                             ......
REQUEST,OLDDATA,HI.  PLEASE MOUNT REEL  . 1B . .
                                            ......                   ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
REQUEST,NEWDATA,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE              ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.
                                            .....
REQUEST,TAPE08,HI.   PLEASE MOUNT REEL  . 2 . .
                               .....        .....          .....
COMMENT. LABEL,TAPE08,R,L= . C . ,M=UNIT08,T=999,VSN= . 2 . .
REWIND,TAPE08.                 .....                       .....
REWIND,FL0801,FL0802,FL0803,FL0804,FL0805.
COPYBF,TAPE08,FL0801.
COPYBF,TAPE08,FL0802.
COPYBF,TAPE08,FL0803.
COPYBF,TAPE08,FL0804.
COPYBF,TAPE08,FL0805.
UNLOAD,TAPE08.

LDSET,SUBST=OVERLA4-OVERLAY.
NEWLGO,INPDATA,PL=500000.

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

FASTOP - EXECUTION - SOP(JCL)

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

REQUEST,TAPE01,HI.            .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE01,W,L= . A . ,M=UNIT01,T=999.
REWIND,TAPE01.                .....
REWIND,FL0101,FL0102,FL0103,FL0104,FL0105.
COPYBF,FL0101,TAPE01.
COPYBF,FL0102,TAPE01.
COPYBF,FL0103,TAPE01.
COPYBF,FL0104,TAPE01.
COPYBF,FL0105,TAPE01.
UNLOAD,TAPE01.

EXIT.
DMP,000100,237100.
.......
. EOR .  END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
.                                                                      .
........................................................................
.     FORTRAN UPDATES                                                  .
........................................................................
.                                                                      .
.......
. EOR .  END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
.                                                                      .
........................................................................
........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES              .
.             IF CASE IS TO BE CHANGED BEFORE EXECUTING.               .
........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD.  END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************


.....
. A .  SCTOSC.PXX.PPPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE01
.....  ----------------------------------

.....
. C .  SCTOSO.PYY.PPPPPP  (DSIO - INPUT)   SCOPE FILE TAPE08
.....  ---------------------------------


.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

.....                                      .....
. 2 .  REEL NUMBER ASSOCIATED WITH DSNAME  . C .
.....                                      .....
```

SUBSEQUENT PASS
COMMUNICATION FROM FOP TO SOP
COMMUNICATION FROM SOP TO FOP
STIFFNESS OR FLEXIBILITY APPROACH

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


***************************
* ACCOUNTING INFORMATION *
***************************

.......................................................................
.                                                                     .
. JOB CARD         - PROVIDED BY THE USER                             .
.                    EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING .
.                    DATA, AND OTHER PERTINENT INFORMATION            .
.                                                                     .
.......................................................................


***************************
* SPECIAL INSTRUCTIONS    *
***************************

                               ......
COMMENT. PLEASE MOUNT REEL . 1A . .   SAVE SCOPE FILE NEWTAPE.
                               ......
COMMENT. PLEASE MOUNT REEL . 1B . .   SAVE SCOPE FILE NEWDATA.
                               ......
COMMENT. PLEASE MOUNT REEL . 2 . .
                               .....
COMMENT. PLEASE MOUNT REEL . 3 . .
                               .....
COMMENT. SAVE SCOPE FILE TAPE01.
COMMENT. SAVE SCOPE FILE TAPE09.
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST     VOLUME
                    .....
COMMENT.     --     . A .         7          VAULT
                    .....
COMMENT.     --     . B .         7          VAULT
                    .....

***************************
* JOB CONTROL LANGUAGE    *
***************************


.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                                                     ......
REQUEST,OLDTAPE,HI.   PLEASE MOUNT REEL . 1A . .
                                                     ......                           ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
REQUEST,NEWTAPE,HI.   PLEASE MOUNT SCRATCH TAPE AND SAVE              ......
COMMENT. LABEL,NEWTAPE,W,L=$FASTOP.SOP.D75030$,M=NEWPL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.                                      ......
REQUEST,OLDDATA,HI.   PLEASE MOUNT REEL . 1B . .
                                                     ......                           ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
REQUEST,NEWDATA,HI.   PLEASE MOUNT SCRATCH TAPE AND SAVE              ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.
                                                     .....
REQUEST,TAPE08,HI.    PLEASE MOUNT REEL . 2 . .
                                        .....        .....              .....
COMMENT. LABEL,TAPE08,R,L= . C . ,M=UNIT08,T=999,VSN= . 2 . .
REWIND,TAPE08.                          .....                           .....
REWIND,FL0801,FL0802,FL0803,FL0804,FL0805.
COPYBF,TAPE08,FL0801.
COPYBF,TAPE08,FL0802.
COPYBF,TAPE08,FL0803.
COPYBF,TAPE08,FL0804.
COPYBF,TAPE08,FL0805.
UNLOAD,TAPE08.
                                                     .....
REQUEST,TAPE10,HI.    PLEASE MOUNT REEL . 3 . .
                                                     .....

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                                  .....                          .....
COMMENT. LABEL,TAPE10,R,L=  . D .  ,M=UNIT10,T=999,VSN=  . 3 . .
REWIND,TAPE10.                    .....                          .....
REWIND,FL1001.
COPYBF,TAPE10,FL1001.
UNLOAD,TAPE10.

LDSET,SUBST=OVERLA4-OVERLAY.
NEWLGO,INPDATA,PL=500000.

REQUEST,TAPE01,HI.                .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE01,*,L=  . A .  ,M=UNIT01,T=999.
REWIND,TAPE01.                    .....
REWIND,FL0101,FL0102,FL0103,FL0104,FL0105.
COPYBF,FL0101,TAPE01.
COPYBF,FL0102,TAPE01.
COPYBF,FL0103,TAPE01.
COPYBF,FL0104,TAPE01.
COPYBF,FL0105,TAPE01.
UNLOAD,TAPE01.

REQUEST,TAPE09,HI.                .....  PLEASE MOUNT SCRATCH TAPE AND SAVE.
COMMENT. LABEL,TAPE09,W,L=  . B .  ,M=UNIT09,T=999.
REWIND,TAPE09.                    .....
REWIND,FL0901,FL0902,FL0903,FL0904,FL0905,FL0906.
COPYBF,FL0901,TAPE09.
COPYBF,FL0902,TAPE09.
COPYBF,FL0903,TAPE09.
COPYBF,FL0904,TAPE09.
COPYBF,FL0905,TAPE09.
COPYBF,FL0906,TAPE09.
UNLOAD,TAPE09.

EXIT.
DMP,000100,237100.
.......
. EOR .   END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
.                                                                      .
........................................................................
.      FORTRAN UPDATES                                                 .
........................................................................
.                                                                      .
.......
. EOR .   END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
.                                                                      .
........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES              .

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

.              IF CASE IS TO BE CHANGED BEFORE EXECUTING.               .
........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD.  END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************


.....
. A .  SOTOSO.PXX.PPPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE01  )
.....  ---------------------------------

.....
. B .  SOTOFO.PXX.PPPPPP  (DSIO - OUTPUT)  SCOPE FILE TAPE09
.....  ---------------------------------

.....
. C .  SOTOSO.PYY.PPPPPP  (DSIO - INPUT)   SCOPE FILE TAPE08
.....  --------------------------------

.....
. D .  FOTOSO.PZZ.PPPPPP  (DSIO - INPUT)   SCOPE FILE TAPE10
.....  --------------------------------

.....                                     .....
. 2 .  REEL NUMBER ASSOCIATED WITH DSNAME . C .
.....                                     .....

.....                                     .....
. 3 .  REEL NUMBER ASSOCIATED WITH DSNAME . D .
.....                                     .....

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

FOP MAJOR ANALYSIS AND OPTIMIZATION OPTIONS
OPTION 7

PERFORM VIBRATION ANALYSIS
DO NOT PERFORM FLUTTER ANALYSIS
DO NOT PERFORM FLUTTER OPTIMIZATION
(WITH PLOTTING)

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


***************************
* ACCOUNTING INFORMATION *
***************************

........................................................................
.                                                                      .
. JOB CARD          PROVIDED BY THE USER                               .
.                   EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING .
.                   DATA, AND OTHER PERTINENT INFORMATION              .
.                                                                      .
........................................................................


***************************
* SPECIAL INSTRUCTIONS    *
***************************

                             ......
COMMENT. PLEASE MOUNT REEL . 1A . .  SAVE SCOPE FILE NEWTAPE.
                             ......
COMMENT. PLEASE MOUNT REEL . 1B . .  SAVE SCOPE FILE NEWDATA.
                             ......
COMMENT. PLEASE MOUNT REEL . 2 . .
                             .....                                ......
COMMENT. PLEASE MOUNT REEL . 3 . .                                . 2A .
                             .....                                ......
COMMENT. SAVE SCOPE FILE TAPE17.
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST     VOLUME
                   .....                                          ......
COMMENT.    --     . A .          7          VAULT                . 3A .
                   .....                                          ......
COMMENT.    --     . B .          7          VAULT                . 4A .
                   .....                                          ......

***************************
* JOB CONTROL LANGUAGE    *
***************************



.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

FASTOP - EXECUTION - FOP(JCL)

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
                                                ......
REQUEST,OLDTAPE,HI.  PLEASE MOUNT REEL . 1A . .
                                                ......                  ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
                                                                        ......
REQUEST,NEWTAPE,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE
COMMENT. LABEL,NEWTAPE,W,L=$FASTOP.SOP.D75030$,M=NEWPL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.
                                                ......
REQUEST,OLDDATA,HI.  PLEASE MOUNT REEL . 1B . .
                                                ......                  ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
                                                                        ......
REQUEST,NEWDATA,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.
```

```
                                                                        ......
REQUEST,TAPE17,HI.  PLEASE MOUNT SCRATCH REEL AND SAVE.                 . 3B .
                                    .....                               ......
COMMENT.  LABEL,TAPE17,W,L= . A . ,M=UNIT17,T=999.
                            .....
                                           .....
REQUEST,TAPE05.  PLEASE MOUNT REEL . 2 .
                            .....  .....                 .....
COMMENT.  LABEL,TAPE05,R,L= . D . ,M=UNIT05,T=999,VSN= . 2 .
REWIND,TAPE05.              .....                        .....
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

FASTOP - EXECUTION - FOP(JCL)

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

COPYBF,TAPE05,FL0501.
COPYBF,TAPE05,FL0502.
COPYBF,TAPE05,FL0503.
COPYBF,TAPE05,FL0504.
COPYBF,TAPE05,FL0505.
COPYBF,TAPE05,FL0506.
REWIND,FL0501,FL0502,FL0503,FL0504,FL0505,FL0506.
UNLOAD,TAPE05.

REWIND,TAPE08.                          .....                        ......
REQUEST,TAPE08,HI.  PLEASE MOUNT REEL . 3 .                          . 2B .
                                .....   .....              .....     ......
COMMENT.  LABEL,TAPE08,R,L=  . E . ,M=UNIT08,T=999,VSN=  . 3 .
COPYBF,TAPE08,FL0801.           .....                      .....
COPYBF,TAPE08,FL0802.
COPYBF,TAPE08,FL0803.
COPYBF,TAPE08,FL0804.
COPYBF,TAPE08,FL0805.
COPYBF,TAPE08,FL0806.
COPYBF,TAPE08,FL0807.
COPYBF,TAPE08,FL0808.
REWIND,FL0801,FL0802,FL0803,FL0804,FL0805,FL0806,FL0807,FL0808.
UNLOAD,TAPE08.

LDSET,SUBST=OVERLA4-OVERLAY.
NEWLGO,INPDATA,PL=50000.

.......
. EOR .  END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
.
........................................................................
.     FORTRAN UPDATES.                                                 .
........................................................................
.
.......
. EOR .  END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
.
........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES              .
.             IF CASE IS TO BE CHANGED BEFORE EXECUTING.               .
........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD. END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

......          .....
. 2A . INPUT TAPE . 3 . IS NOT REQUIRED IF KLUE(26) = 0 (ITEM 6 IN FOP).
......          .....

......
. 2B . DELETE ALL CARDS ASSOCIATED WITH SCOPE FILE TAPE08 AND DSIO FILES
...... FL08NN (NN = 01 TO 08) IF THIS IS THE FIRST PASS IN FOP
       (KLUE(26) = 0).

......
. 3A . DELETE THIS STATEMENT IF THE USER DOES NOT DESIRE TO SAVE THF
...... VIBRATION RESULTS ON TAPE.

......
. 3B . DELETE ALL CARDS ASSOCIATED WITH SCOPE FILE TAPE17 IF
...... VIERATION RESULTS ARE NOT TO BE SAVED ON TAPE.

......
. 4A . IF CALCCMP PLCTTING IS CALLED FOR, (KLUEV(2) = 2, ITEM 3
...... IN AVAM) SAVE THIS DATA SET FOR PLOTTING.
......

......
. 4B . DELETE THIS PROCEDURE IF CALCOMP PLOTTING IS NOT DESIRED,
...... (KLUEV(2) = 0).

INPUT TAPES
-----------

.....
. D .  SOTOFO.PYY.PPPPPP (DSIO)             SCOPE FILE TAPE05
.....  ------------------------

.....
. E .   FCTOFO.PXX.PPPPP (DSIO)             SCOPE FILE TAPE08
.....   -----------------------

.....                                .....
. 2 .  REEL NUMBER ASSOCIATED WITH DSNAME . D . .
.....                                .....

.....                                .....
. 3 .  REEL NUMBER ASSOCIATED WITH DSNAME . E . .
......                               .....

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

OUTPUT TAPES

```
.....
. A .   VIBRAT.PYY.PPPPP (FSIO)                SCOPE FILE TAPE17
.....   -----------------------

.....
. B .   PLOT.PYY.PPPPPP (FSIO)
.....   ------------------------
        INCLUDE APPROPRIATE JCL FOR SAVING THE PLOT INFORMATION.
```

```
                 FOP MAJOR ANALYSIS AND OPTIMIZATION OPTIONS
                                  CPTION 8

                      DC NOT PERFORM VIBRATION ANALYSIS
                          PERFORM FLUTTER ANALYSIS
                     DC NOT PERFORM FLUTTER OPTIMIZATION
                              (WITH PLCTTING)

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


**************************
* ACCOUNTING INFORMATION *
**************************

........................................................................
.                                                                      .
. JOB CARD        - PROVIDED BY THE USER                               .
.                   EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING .
.                   DATA, AND CTHER PERTINENT INFORMATION              .
.                                                                      .
........................................................................


**************************
* SPECIAL INSTRUCTIONS   *
**************************

                            ......
COMMENT. PLEASE MOUNT REEL . 1A . .  SAVE SCOPE FILE NEWTAPE.
                            ......
COMMENT. PLEASE MOUNT REEL . 1B . .  SAVE SCOPE FILE NEWDATA.
                            ......                               ......
COMMENT. PLEASE MOUNT REEL . 2 . .                               . 2A .
                            .....                                ......
COMMENT. PLEASE MOUNT REEL . 3 . .                               . 3A .
                            .....                                ......
                                                                 ......
COMMENT. SAVE SCOPE FILE TAPE31.                                 . 3D .
                                                                 ......
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST     VOLUME
                   .....                                         ......
COMMENT.    --   . A .          7            VAULT               . 3A .
                   .....                                         ......
COMMENT.    --   . B .          7            VAULT               . 4A .
                   .....                                         ......

**************************
* JOB CONTROL LANGUAGE   *
**************************


.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                      FASTCP - EXECUTION - FOP(JCL)
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                                                         ......
REQUEST,OLDTAPE,HI.  PLEASE MOUNT REEL . 1A . .
                                                         ......                   ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
REQUEST,NEWTAPE,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE                           ......
COMMENT. LABEL,NEWTAPE,W,L=$FASTOP.SOP.D75030$,M=NEWPL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.
                                                         ......
REQUEST,OLDDATA,HI.  PLEASE MOUNT REEL . 1B . .
                                                         ......                   ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
REQUEST,NEWDATA,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE                           ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.
                                                        .....                     ......
REQUEST,TAPE17,HI.  PLEASE MOUNT REEL . 2 ..                                      . 2B .
                                              .....     .....           .....     ......
COMMENT.  LABEL,TAPE17,R,L = . D . ,M=UNIT17,7=999,VSN= . 2 .
                                              .....                     .....

                                                        .....                     ......
REQUEST,TAPE31,HI.  PLEASE MOUNT REEL . 3 ..                                      . 3C .
                                              .....     .....           .....     ......
COMMENT.  LABEL,TAPE31,R,L = . A . ,M=UNIT31,7=999,VSN= . 3 .
                                              .....                     .....

LDSET,SUBST=OVERLA4-OVERLAY.
NEWLGO,INPDATA,PL=50000.

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

UNLOAD,TAPE17.                                                    ......
UNLOAD,TAPE31.                                                    . 3D .
                                                                  ......

.......
. EOR .  END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
.
........................................................................
.     FORTRAN UPDATES.                                                 .
........................................................................
.
.......
. EOR .  END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
.
........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES               .
.               IF CASE IS TO BE CHANGED BEFORE EXECUTING.             .
........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD. END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************


......            .....
. 2A . INPUT TAPE . 2 . IS NOT REQUIRED IF IN = 1. IN=1 (ITEM 5 IN AFAM)
......            .....
       INDICATES THAT THE USER IS SUPPLYING VIBRATION DATA IN CARD FORM.

......
. 2B . DELETE ALL CARDS ASSOCIATED WITH SCOPE FILE TAPE17 IF IN = 1.
......


......            .....
. 3A . INPUT TAPE . 3 . IS REQUIRED ONLY IF LC(22) = 1 (ITEM 4 IN AFAM)
......            .....
       LC(22) = 1 INDICATES THAT A PREVIOUSLY GENERATED SET OF
       AERODYNAMIC INFLUENCE COEFFICIENTS (AIC) IS BEING SUPPLIED
       ON TAPE.

......
. 3B . DELETE THIS STATEMENT IF THE AIC ARE NOT BEING GENERATED AND
...... SAVED IN THIS RUN.

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

......
. 3C .  IF PREVIOUSLY SAVED AIC'S ARE NOT BEING SUPPLIED TO THE PROGRAM.
......  (LC(22) OTHER THAN +1), CHANGE THE PARAMETERS ON THIS CARD AS
        FOLLOWS.
        IF AIC'S ARE TO GENERATED AND SAVED REPLACE THESE TWO CARDS
        ASSOCIATED WITH SCOPE FILE TAPE31 WITH THE FOLLOWING TWO CARDS.
        REQUEST.TAPE31.HI.  PLEASE MOUNT SCRATCH REEL AND SAVE.

                                       .....
        COMMENT.  LABEL.TAPE31.W. L =  . A .  .M=UNIT31.T=999.
                                       .....
        IF AIC'S ARE TO BE GENERATED BUT NOT SAVED ELIMINATE THE TWO
        CARDS ASSOCIATED WITH SCOPE FILE TAPE31.
......
. 3D .  IF AIC'S ARE TO BE GENERATED BUT NOT SAVED ELIMINATE THIS
......  INSTRUCTION.

......
. 4A .  IF CALCCMP PLOTTING IS CALLED FOR, (LC(14) = 1 IN AFAM),
......  SAVE THIS DATA SET FOR PLOTTING.

INPUT TAPES
-----------

.....
. A .   AIC.PPPPP (FSIO)                           SCOPE FILE TAPE31
.....   ----------------

.....
. D .   VIBRAT.PXX.PPPPP (FSIO)                    SCOPE FILE TAPE17
.....    --------------

.....                                          .....
. 2 .   REEL NUMBER ASSOCIATED WITH DSNAME     . D . .
.....                                          .....

.....                                          .....
. 3 .   REEL NUMBER ASSOCIATED WITH DSNAME     . A . .
......                                         .....

OUTPUT TAPES
------------

.....
. A .   AIC.PPPPP (FSIO)                           SCOPE FILE TAPE31
.....   ----------------


.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

.....
. B .   PLOT.PYY.PPPPPP
.....   ---------------
        INCLUDE APPROPRIATE JCL FOR SAVING THE PLOT INFORMATION.
```

FOP MAJOR ANALYSIS AND OPTIMIZATION OPTIONS
OPTIONS 9 AND 10

PERFORM VIBRATION ANALYSIS
PERFORM FLUTTER ANALYSIS
A) PERFORM FLUTTER OPTIMIZATION
OR
B) DO NOT PERFORM FLUTTER OPTIMIZATION
(WITH PLOTTING)

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


**************************
* ACCOUNTING INFORMATION *
**************************

........................................................................
.                                                                      .
. JOB CARD           PROVIDED BY THE USER                              .
.                    EXECUTION TIME, PRINTED LINE ESTIMATES, ACCOUNTING .
.                    DATA, AND OTHER PERTINENT INFORMATION             .
.                                                                      .
........................................................................


**************************
* SPECIAL INSTRUCTIONS   *
**************************

                             ......
COMMENT. PLEASE MOUNT REEL . 1A . .  SAVE SCOPE FILE NEWTAPE.
                             ......
COMMENT. PLEASE MOUNT REEL . 1B . .  SAVE SCOPE FILE NEWDATA.
                             ......
COMMENT. PLEASE MOUNT REEL . 2 . .
                             .....                                 ......
COMMENT. PLEASE MOUNT REEL . 3 . .                                 . 2A .
                             .....                                 ......
COMMENT. PLEASE MOUNT REEL . 4 . .                                 . 3A .
                             .....                                 ......
COMMENT. SAVE SCOPE FILE TAPE17.                                   . 4A .
                                                                   ......
COMMENT. SAVE SCOPE FILE TAPE31.                                   . 3D .
                                                                   ......
COMMENT.  OUTPUT DATA SET NAME TRK RET/REV   DEST     VOLUME
                 .....                                             ......
COMMENT.    --   . A .          7            VAULT                 . 5A .
                 .....                                             ......
COMMENT.    --   . B .          7            VAULT                 . 5A .
                 .....                                             ......

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

                 .....                                                .....
COMMENT.    --   . C .          7                VAULT                . 4A .
                 .....                                                ......
COMMENT.    --   . D .          7                VAULT                . 3B .
                 .....                                                ......
COMMENT.    --   . E .          7                VAULT                . 6B .
                 .....                                                ......

*************************
* JOB CONTROL LANGUAGE  *
*************************
```

```
                                         ......
REQUEST,OLDTAPE,HI.  PLEASE MOUNT REEL . 1A . .
                                         ......                       ......
COMMENT. LABEL,OLDTAPE,R,L=$FASTOP.SOP.D75030$,M=OLDPL,T=999,VSN=. 1A ..
REQUEST,NEWTAPE,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE               ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
COPYBR,INPUT,UPDFORT.
REWIND,UPDFORT.
COPYBR,INPUT,UPDDATA.
REWIND,UPDDATA.
UPDATE,P=OLDTAPE,N=NEWTAPE,I=UPDFORT,C=INPFORT,U.
FTN,I=INPFORT,B=UPDLGO,OPT=1,LR,PL=500000.
REWIND,OLDTAPE.
COPYBF,OLDTAPE,OLDFORT.
COPYBF,OLDTAPE,OLDLGO.
REWIND,UPDLGO.
REWIND,OLDLGO.
COPYL,OLDLGO,UPDLGO,NEWLGO.
REWIND,NEWTAPE.
COPYBF,NEWTAPE,NEWFORT.
REWIND,NEWLGO.
COPYBF,NEWLGO,NEWTAPE.
REWIND,NEWLGO.
UNLOAD,OLDTAPE.
UNLOAD,NEWTAPE.
                                         ......
REQUEST,OLDDATA,HI.  PLEASE MOUNT REEL . 1B . .
                                         ......                       ......
COMMENT. LABEL,OLDDATA,R,L=$FASTOP.DATA.D5030$,M=OLDDL,T=999,VSN=. 1B ..
REQUEST,NEWDATA,HI.  PLEASE MOUNT SCRATCH TAPE AND SAVE               ......
COMMENT. LABEL,NEWDATA,W,L=$FASTOP.DATA.D5030$,M=NEWDL,T=999.
UPDATE,P=OLDDATA,N=NEWDATA,I=UPDDATA,C=INPDATA,D,U,L=F.
UNLOAD,OLDDATA.
UNLOAD,NEWDATA.
REWIND,INPDATA.
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


                                                                 ......
REQUEST,TAPE17,HI.  PLEASE MOUNT SCRATCH REEL AND SAVE.          . 4B .
                                  .....                          ......
COMMENT.  LABEL,TAPE17,*,L=  . C .  ,M=UNIT17,T=999.
                                  .....
                                          .....                  ......
REQUEST,TAPE31,HI.  PLEASE MOUNT REEL  . 4 ..                    . 3C .
                                   .....  .....          .....   ......
COMMENT.  LABEL,TAPE31,R,L =  . D .  ,M=UNIT31,7=999,VSN=  . 4 .
                                   .....                 .....


                                       .....
REQUEST,TAPE05.  PLEASE MOUNT REEL  . 2 .
                                  .....  .....          .....
COMMENT.  LABEL,TAPE05,R,L=  . G .  ,M=UNIT05,T=999,VSN=  . 2 .
REWIND,TAPE05.                    .....                 .....
COPYBF,TAPE05,FL0501.
COPYBF,TAPE05,FL0502.
COPYBF,TAPE05,FL0503.
COPYBF,TAPE05,FL0504.
COPYBF,TAPE05,FL0505.
COPYBF,TAPE05,FL0506.
REWIND,FL0501,FL0502,FL0503,FL0504,FL0505,FL0506.
UNLOAD,TAPE05.

REWIND,TAPE08.                            .....                  ......
REQUEST,TAPE08,HI.  PLEASE MOUNT REEL  . 3 .                     . 2B .
                                  .....   .....         .....    ......
COMMENT.  LABEL,TAPE08,R,L=  . H .  ,M=UNIT08,T=999,VSN=  . 3 .
COPYBF,TAPE08,FL0801.             .....                 .....
COPYBF,TAPE08,FL0802.
COPYBF,TAPE08,FL0803.
COPYBF,TAPE08,FL0804.
COPYBF,TAPE08,FL0805.
COPYBF,TAPE08,FL0806.
COPYBF,TAPE08,FL0807.
COPYBF,TAPE08,FL0808.
REWIND,FL0801,FL0802,FL0803,FL0804,FL0805,FL0806,FL0807,FL0808.
UNLOAD,TAPE08.

LDSET,SUBST=OVERLA4-OVERLAY
NEWLGO,INPDATA,PL=50000.
                                                                 ......
REQUEST,TAPE06,HI.  PLEASE MOUNT SCRATCH REEL AND SAVE.          . 5A .
                                                                 ......

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012


                                        .....
COMMENT.  LABEL.TAPE06.W.L=  . A .  .M=UNIT06.T=999.
REWIND,TAPE06.                          .....
REWIND,FL0601.
COPYBF,FL0601,TAPE06.
UNLOAD,TAPE06.
                                                                  ......
REQUEST,TAPE07,HI.  PLEASE MOUNT SCRATCH REEL AND SAVE.           . 5B .
                                        .....                     ......
COMMENT.  LABEL.TAPE07,W,L=  . B .  .M=UNIT07.T=999.
REWIND,TAPE07.                          .....
REWIND,FL0701,FL0702,FL0703,FL0704,FL0705,FL0706,FL0707,FL0708.
COPYBF,FL0701,TAPE07.
COPYBF,FL0702,TAPE07.
COPYBF,FL0703,TAPE07.
COPYBF,FL0704,TAPE07.
COPYBF,FL0705,TAPE07.
COPYBF,FL0706,TAPE07.
COPYBF,FL0707,TAPE07.
COPYBF,FL0708,TAPE07.
UNLOAD,TAPE07.
.......
. EOR .  END OF JCL CARDS.  END OF RECORD.  FORTRAN UPDATES FOLLOW.
.......
.
........................................................................
.      FORTRAN UPDATES.                                                .
........................................................................
.
.......
. EOR .  END OF FORTRAN UPDATES.  END OF RECORD.  DATA UPDATES FOLLOW.
.......
.
........................................................................
. CARD DATA - USE *COMPILE CASEXXX OR APPROPRIATE UPDATES              .
.              IF CASE IS TO BE CHANGED BEFORE EXECUTING.              .
........................................................................
.......
. EOF .  END OF DATA UPDATES.  END OF RECORD. END OF INFORMATION.
.......

**************************
* FOOTNOTES              *
**************************

......          .....
. 2A .  INPUT TAPE . 3 . IS NOT REQUIRED IF KLUE(26) = 0 (ITEM 6 IN FOP).
......          .....


.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

......
. 2B . DELETE ALL CARDS ASSOCIATED WITH SCOPE FILE TAPE08 AND DSIO FILES
...... FL08NN (NN = 01 TO 08) IF THIS IS THE FIRST PASS IN FOP
       (KLUE(26) = 0).

......               .....
. 3A . INPUT TAPE . 3 . IS REQUIRED ONLY IF LC(22) = 1 (ITEM 4 IN AFAM)
......               .....
       LC(22) = 1 INDICATES THAT A PREVIOUSLY GENERATED SET OF
       AERODYNAMIC INFLUENCE COEFFICIENTS (AIC) IS BEING SUPPLIED
       ON TAPE.

......
. 3B . DELETE THIS STATEMENT IF THE AIC'S ARE NOT BEING GENERATED AND
...... SAVED IN THIS RUN.

......
. 3C . IF PREVIOUSLY SAVED AIC'S ARE NOT BEING SUPPLIED TO THE PROGRAM.
...... (LC(22) OTHER THAN +1), CHANGE THE PARAMETERS ON THIS CARD AS
       FOLLOWS --
       IF AIC'S ARE TO GENERATED AND SAVED REPLACE THESE TWO CARDS
       ASSOCIATED WITH SCOPE FILE TAPE31 WITH THE FOLLOWING TWO CARDS.
       REQUEST,TAPE31,HI.  PLEASE MOUNT SCRATCH REEL AND SAVE.
                                       .....
       COMMENT.  LABEL,TAPE31,W, L = . D . ,M=UNIT31,T=999.
                                       .....
       IF AIC'S ARE TO BE GENERATED BUT NOT SAVED ELIMINATE THE TWO
       CARDS ASSOCIATED WITH SCOPE FILE TAPE31.

......
. 3D . IF AIC'S ARE TO BE GENERATED BUT NOT SAVED, ELIMINATE THIS
...... INSTRUCTION.

......
. 4A . DELETE THIS STATEMENT IF THE USER DOES NOT DESIRE TO SAVE THE
...... VIBRATION RESULTS ON TAPE.

.....
. 4B . DELETE ALL CARDS ASSOCIATED WITH SCOPE FILE TAPE17 IF
...... VIBRATION RESULTS ARE NOT TO BE SAVED ON TAPE.

......
. 5A . INCLUDE ALL STATEMENTS ASSOCIATED WITH SCOPE FILE TAPE06 AND
...... DSIO FILES FL0601 IF FLUTTER REDESIGN IS TO
       BE PERFORMED IN THIS RUN. (KLUE(7) = 7 AND KLUE(34) = 34).

......
. 5B . INCLUDE ALL STATEMENTS ASSOCIATED WITH SCOPE FILE TAPE07 AND
...... DSIO FILES FL07NN (NN = 01 TO 05) IF FLUTTER REDESIGN IS TO

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

       BE PERFORMED IN THIS RUN. (KLUE(7) = 7 AND KLUE(34) = 34).



......
. 6B . DELETE THIS STATEMENT IF CALCOMP PLOTTING IS NOT DESIRED.
...... (KLUEV(2) = 0 AND LC(14) = 0).

INPUT TAPES
-----------

.....
. D .  AIC.PPPPPP (FSIO)                  SCOPE FILE TAPE31
.....  -----------------

.....
. G .  SCTOFO.PYY.PPPPPP (DSIO)           SCOPE FILE TAPE05
.....  ------------------------

.....
. H .  FOTOFO.PXX.PPPPPP (DSIO)           SCOPE FILE TAPE08
.....  ------------------------

.....                                   .....
. 2 .  REEL NUMBER ASSOCIATED WITH DSNAME . G . .
.....                                   .....

.....                                   .....
. 3 .  REEL NUMBER ASSOCIATED WITH DSNAME . H . .
.....                                   .....

.....                                   .....
. 4 .  REEL NUMBER ASSOCIATED WITH DSNAME . D . .
.....                                   .....

OUTPUT TAPES
------------

.....
. A .  FOTOSO.PYY.PPPPPP (DSIO)           SCOPE FILE TAPE06
.....  ------------------------

.....
. B .  FOTOFO.PYY.PPPPPP (DSIO)           SCOPE FILE TAPE07
.....  ------------------------


.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```

```
.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012

.....
. C .   VIBRAT.PYY.PPPPPP (FSIO)            SCOPE FILE TAPE17
.....   ------------------------

.....
. D .   AIC.PPPPPP (FSIO)                   SCOPE FILE TAPE31
.....   -----------------

.....
. E .   PLOT.PYY.PPPPPP
.....   ---------------
        INCLUDE APPROPRIATE JCL FOR SAVING THE PLOT INFORMATION.

.........1.........2.........3.........4.........5.........6.........7..
123456789012345678901234567890123456789012345678901234567890123456789012
```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DEPARTMENT OF THE AIR FORCE
WRIGHT LABORATORY (AFMC)
WRIGHT-PATTERSON AIR FORCE BASE OHIO

ERRATA

1 Feb 96

MEMORANDUM FOR Defence Technical Information Center
8725 John J. Kingman Road, Suite 0944
Ft. Belvoir, VA 22060-6218

FROM: WL/DORT, Bldg 22
2690 C St Ste 4
Wright-Patterson AFB, OH 45433-7411

SUBJECT: Notice of Changes in Technical Report(s) AD B009874, AD B009781, AD B029162, AD B029330.

Please change subject report(s) as follows:

AFFDL-TR-75-137, Vol 1 (AD B009874): has been cleared for public release (State A).

AFFDL-TR-75-137, Vol II (ADB009781): has been cleared for public release (State A).

AFFDL-TR-78-50, Vol I (ADB029162): has been cleared for public release (State A).

AFFDL-tr-78-50, Vol II (ADB029330): has been cleared for public release (State A).

WL-TR-95-8014 (printed in Jan 95): Distribution statement should read as C - (B208214) Dist. authorized to US Gov Agencies and their contractors...

WL-TR-95-8015(printed in Jan 95): should read as Distribution Statement C - (B206558) Dist. authorized to US Gov agencies and their contractors....

ERRATA
AD-B009781

Joseph A. Burke
JOSEPH A. BURKE, Team Leader
STINFO and Technical Editing
Technical Information Branch